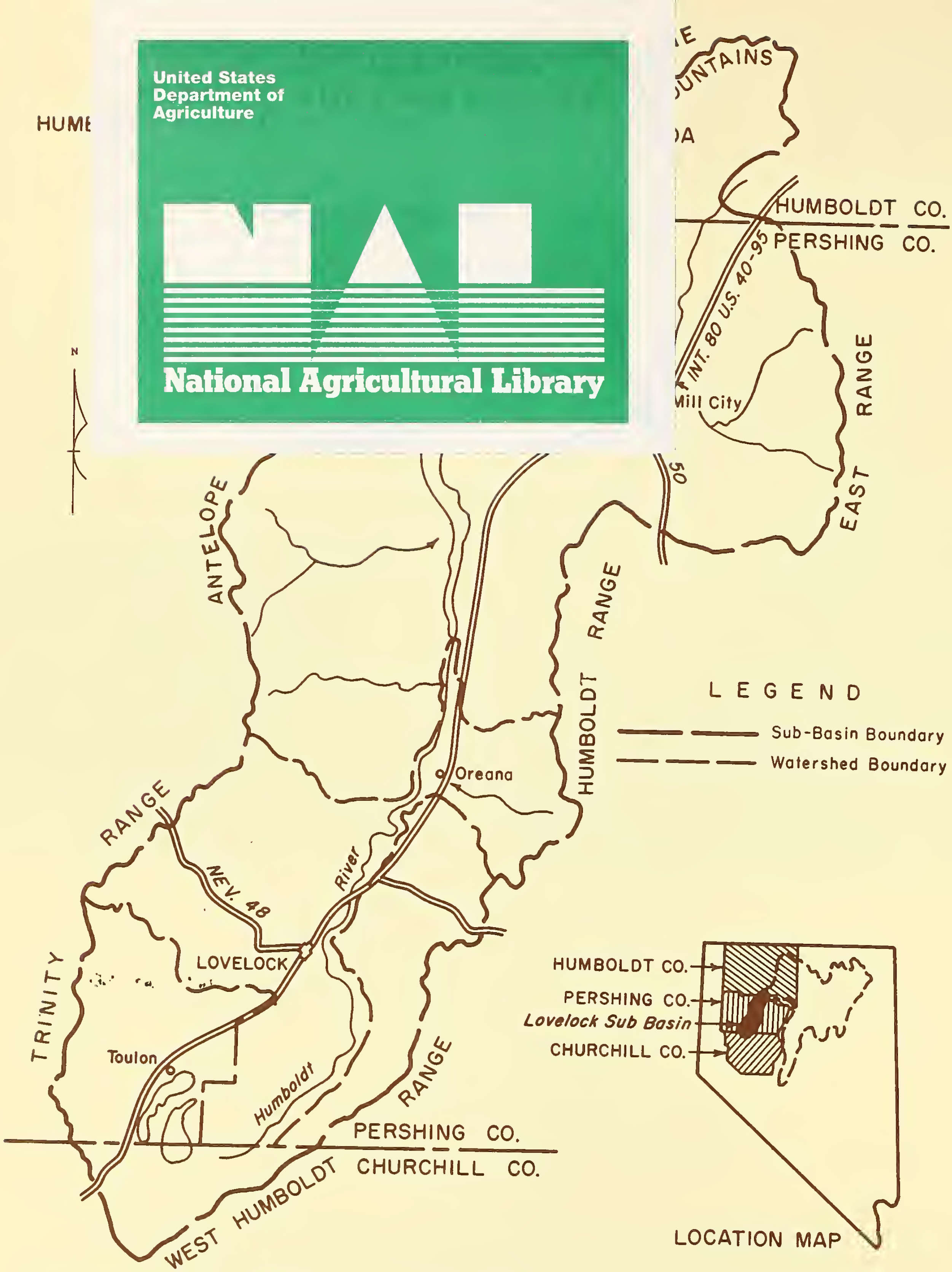
ER and RELATED LAND RESOURCES
MBOLDT RIVER BASIN
NEVADA

REPORT NUMBER ELEVEN
LOVELOCK SUB-BASIN
OCTOBER 1965

Based on a Cooperative Survey
by
THE NEVADA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
and THE UNITED STATES DEPARTMENT OF AGRICULTURE

Prepared by
Economic Research Service - Forest Service - Soil Conservation Service

5/10/66
cc: Beatti



COVER PHOTOGRAPH

The montage of three photographs represents the essence of the Lovelock Sub-Basin's principal activity - diversified agriculture. Water from Rye Patch Reservoir (center photograph) is used in Lovelock Valley to raise alfalfa, sugar beets, small grain, and corn for silage (left photograph). The grains and corn silage are in turn utilized in the fattening of feeder cattle (right photograph), which is fast becoming one of Lovelock Valley's principal agricultural enterprises.

FIELD PARTY PHOTOS 6-893-5, 6-868-10
SCS PHOTO 6-786-9

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REGISTER

REPORT NUMBER ELEVEN

LOVELOCK SUB-BASIN

OCTOBER 1965

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Humboldt River Basin Field Party
P.O. Box 228
Carson City, Nevada 89701

Name ______________________________

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WATER AND RELATED LAND RESOURCES

REPORT NUMBER ELEVEN

HUMBOLDT RIVER BASIN

NEVADA

LOVELOCK SUB-BASIN

Based on a Cooperative Survey
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The United States Department of Agriculture

Forest Service - Soil Conservation Service
Economic Research Service

October 1965

FOREWORD

This is a report for the people of Nevada, and particularly for the people of the Humboldt River Basin, concerning water and related land resources in the Lovelock Sub-Basin. It is the eleventh of a series of reports resulting from a cooperative survey of the Humboldt River Basin by the Nevada State Department of Conservation and Natural Resources and the U.S. Department of Agriculture. It was prepared by the Soil Conservation Service, Forest Service and the Economic Research Service of the Department of Agriculture.

The State of Nevada seeks constantly to assist local people and their organizations in the conservation, development and management of water resources. It has particular regard for the relationship of water to land and to human resources. This is exemplified by the creation of the Nevada State Department of Conservation and Natural Resources. A primary responsibility of that Department is to cooperate with Federal agencies and local groups, and to coordinate State-Federal activities that help solve water and related land problems for the people of Nevada.

The responsibilities of the Nevada State Department of Conservation and Natural Resources, and the cooperative research work already under way in the Humboldt River, set the stage for Federal-State cooperation in developing information on opportunities for improving the use of the land and water resources of the Basin. Accordingly, cooperation was initiated with the U.S. Department of Agriculture under a Plan of Work dated June 3, 1960 with agencies of the Department and of the State of Nevada participating in the survey. It is important here to point out that responsibility for matters concerning State water rights and determination of water supply as it might affect State water rights was assumed by the State of Nevada.

This cooperative survey of the Humboldt River Basin is for the primary purpose of determining where improvements in the use of water and related land resources, some of which have social and economic aspects, might be made with the assistance of projects and programs of the U.S. Department of Agriculture. A major part of the survey is focused on situations where improvement might be brought about by means of Federal-State-local cooperative projects developed under the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress as amended). This survey is in keeping with long-established tradition in the Department of Agriculture of cooperation with States and local entities in the conduct of its work. Further, such cooperation is a most important responsibility of the Nevada State Department of Conservation and Natural Resources.

The U.S. Department of Agriculture-State of Nevada Plan of Work in the Humboldt River Basin offers opportunities for participating in the survey by other Nevada State agencies and Federal agencies. The Bureau of Land Management, as an example, has cooperated with respect to the public domain. Thus, the survey is not limited, but is, rather, as broad in scope and agency participation as is required to meet the agreed-upon objectives.

The entire Humboldt River Basin is being studied by segments identified as sub-basins. This report contains much information for study and use in understanding and solving some of the existing water and land resource problems in the Lovelock Sub-Basin. The report presents opportunities for Federal-State-local project-type developments under the present interpretations of the Watershed Protection and Flood Prevention Act, together with other opportunities for development and adjustment.

I wish to recognize the excellent work of the U. S. Department of Agriculture and the State Department of Conservation and Natural Resources in this cooperative effort. I consider that this report will serve the best interest of the people in the Humboldt River Basin and the State of Nevada.

Grant Sawyer

Governor of Nevada

HUMBOLDT RIVER BASIN SURVEY

LOVELOCK SUB-BASIN REPORT

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ORGANIZATION OF REPORT

The report on the Lovelock Sub-Basin is divided into three main sections. The first section is an overall report on the sub-basin; the remaining two sections consist of Appendix I and Appendix II, respectively.

Appendix I is attached to all the report copies, and contains pertinent textual material concerning the sub-basin which is of value to the general reader.

Appendix II is produced in a relatively limited number of copies. Its small appeal to the general reader renders it unsuitable for inclusion with the report copies for general distribution. However, this type of material does have potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Lovelock Sub-Basin. Copies of this appendix are available upon request.

SUMMARY

The Lovelock Sub-Basin is in the southwest part of the Humboldt Basin. It forms a relatively narrow strip from 15 to 20 miles wide and 80 miles long along the Humboldt River between the Rose Creek Gaging Station and the natural dike below Toulon and Humboldt lakes. The sub-basin's 1,048,000 acres lie principally in Pershing County; a small portion on the north is in Humboldt County, while the southern tip is in Churchill County.

This sub-basin, which could be considered the lower gateway to the entire Humboldt Basin, was also the first to be exploited by the white man on a more or less sustained basis, following the period of initial exploration and use by British and American fur trappers.

The first advent of the white man into the sub-basin occurred November 11, 1828, when Hudson's Bay Fur Company brigade leader Peter Skene Ogden entered its upper limits on his fifth Snake Country Expedition. At that time, he proceeded no farther southward along the Humboldt main stem than the vicinity of present Mill City before reversing course and heading eastward for his winter camp in Utah's Wasatch Mountains.

In May and June 1829, Ogden trapped the sub-basin from Rose Creek to its terminus in the sloughs and lakes below present Lovelock. At this time he considered changing his 1828 names for the Humboldt - Unknown River and Paul's River - to Swampy River, because of its many sloughs and swampy areas.

American fur trappers, principally the Bonneville-Walker group of 1833-1834, trapped the Humboldt during the period 1831 to 1846, but with little success.

As with most of the Humboldt Basin, the history of the settlement and exploitation of the Lovelock Sub-Basin may be divided into four periods: fur-trapping, emigration and transportation development, mining, and agriculture. The first period, just described, was the fur-trapping period, 1828-1846. This period slightly overlapped the second, that of westward migration, which started in 1841 with the mounted Bidwell-Bartleson emigrant party. To all intents and purposes, it closed in 1870, following the joining of the Central Pacific and Union Pacific Railroads at Promontory Summit, Utah on May 10, 1869.

The migration and transportation development period in its turn was overlapped by the mining and mineral exploitation era, which started in the spring of 1860 with the discovery of silver, gold and lead deposits in the Humboldt Range. This mining period, which saw the development of many famous camps in or immediately adjacent to the sub-basin - Humboldt City, Dun Glen, Star City, Unionville, Arabia, Rochester, Tungsten - has continued to the present time with short periods of bonanza alternating between long periods of borrasca.

Transportation development began in the latter part of the emigration period with the Chorpenning mail and passenger lines of the 1850's. Chorpenning's operations were followed by the freighting and staging enterprises of William (Hill) Beachey and others in the 1860's not only to the Humboldt Mines but also to the mines of southwest Idaho. The staging era ended with the advent of the Central Pacific Railroad through the sub-basin, July-September 1868.

The station of Lovelock's was established in August 1868 on the Central Pacific in the Big Meadows. First set up to service the Trinity Mining District to the north, Lovelock's became the sub-basin's major town after agriculture became its principal industry,

beginning in the 1880's. Pershing County, with the City of Lovelock as its county seat, was split from Humboldt County March 18, 1919. The 1960 census gace Pershing County's population as 3,199, and the City of Lovelock as 1,948.

The predominant vegetal cover of the sub-basin - about 50 percent of the rangeland - is a mixture of shadscale and bud sagebrush, with shadscale being the more common.

Extensive areas of greasewood, with a sparse understory of such other phreatophytes as saltgrass, green molly, and alkali seepweed, occur on the semi-playa sites east and west of Toulon and Humboldt Lakes, south of the cropland area.

The upland bench and terrace sites throughout the sub-basin serve as transition zones between the plant species common to the valley bottomlands and alluvial fans, and the species found on the mountain slopes and uplands. The principal shrub species prevalent here in various densities and admixtures are shadscale, bud sagebrush, big sagebrush, littleleaf horsebrush, and black sagebrush. Grasses present on the site, usually as a sparse understory to the browse, are Indian ricegrass, bottlebrush squirreltail, desert needlegrass, and Sandberg bluegrass.

In the East Range and the Humboldt and Trinity Ranges, black sagebrush, big sagebrush, Utah juniper or low sagebrush predominates in the vegetal cover on the mountain slopes. In some areas heavy use of the better forage species has allowed the juniper to extend itself beyond its natural habitat, and invade what were once chiefly grassland-shrub range sites.

On the upper slopes and basins of the East and Humboldt Ranges, Idaho fescue, Nevada bluegrass, Cusick bluegrass, oniongrass, and Sandberg bluegrass are the chief grasses. On the West Humboldt Range the chief species present are shadscale and bud sagebrush.

Smallflower tamarisk (salt cedar) occurs in more or less thick-growing clumps and stands on the alkali flat site between Toulon and Humboldt Lakes, and east of Humboldt Lake. Tamarisk also appears as a more or less prominent fringe along the upper margins of Rye Patch Reservoir. Continuing efforts are being made to control tamarisk in these areas.

Considerable barren area, in the form of playas, stretches across the southern tip of Humboldt and Toulon Lakes. Much of the reservoir storage area of the Pitt-Taylor Dams is also classified as playa. The sterile, steep upper slopes of the West Humboldt and Trinity Ranges include extensive areas of barren, rocky, or inaccessible range.

Precipitation for the sub-basin varies from a low of about four inches at Toy to an estimated high of 25 inches on Star Peak in the Humboldt Range. The growing season (28 degrees F) ranges between approximately 142 days in the northern part of the sub-basin to about 160 days in the Lovelock Valley.

Gross water yield is 4,300 acre-feet for an 80 percent frequency year in the sub-basin. Rye Patch Reservoir, which has a total capacity of 192,000 acre-feet, furnishes irrigation water for cropland near Lovelock. For an 80 percent occurrence there are 23,000 acres of cropland irrigated in the Pershing County Water Conservation District. However, approximately 30,000 acres are presently developed for irrigation out of a total acreage with water rights of 37,086. In addition, there are 1,100 acres in Lovelock Valley irrigated through Rye Patch Reservoir, and 2,700 acres outside of Lovelock Valley which have water rights. Alfalfa is the major irrigated crop grown, with approximately

15,000 acres being harvested annually. Small grain (principally wheat), corn silage, irrigated pasture, and sugar beets, are the other crops grown. Alfalfa is the heaviest user of water, with an estimated annual gross consumptive use of 31 inches.

On-the-farm irrigation efficiency is variable, ranging between 25 and 70 percent. Major problems in the sub-basin concerned with water are: (1) high water table; (2) inadequate water control structures, including large diversion structures, as well as small outlet structures in irrigation ditches; (3) seepage losses in canals; and (4) a maze of canals in the distribution system which are often closely parallel.

Inflow of water into Rye Patch Reservoir has been large enough for five years within the period of record to force releases to the Humboldt lakes. Conversely, inflow plus storage has been so low for six separate years that releases have been less than 75,000 acre-feet annually.

The irrigated crops for an 80 percent frequency flow year consumptively use an estimated 45,000 acre-feet of water in the sub-basin. Phreatophytes, both beneficial and nonbeneficial, use an estimated 39,000 acre-feet. Surface evaporation from the Humboldt lakes and playas amounts to approximately 28,200 acre-feet annually. The estimated net surface evaporation rate from Rye Patch Reservoir and the Humboldt lakes is 50 inches.

There are approximately 130 land owners in the sub-basin, not including the ownerships within the boundaries of municipalities, small communities, or other small tract sub-divisions. Approximately 50.4 percent of the total land area is public domain, and 45.5 percent is private land. The remaining 4.1 percent is Bureau of Reclamation withdrawals and county and State lands.

The chief product marketed from the sub-basin is livestock. Cattle numbers have varied widely, because of fluctuating winter-feeding operations, and varying numbers of cattle being shipped from the sub-basin for summer pasture elsewhere. These numbers have ranged from an estimated low of 8,800 head to a high of over 38,000. Sheep numbers have fluctuated over the past 25 years, but presently there are approximately 2,500 head in the sub-basin.

The first specific record of extensive flood damage noted for the sub-basin was the wet-mantle flood period of December 1867 - January 1868. There was heavy flood damage in the vicinity of Dun Glen, as well as around Unionville and in Buena Vista Valley.

The first dry-mantle flood damage of record resulted from cloudbursts falling in the East and Humboldt Ranges in the period July 13-25, 1874.

Following these initial damaging floods, all of the principal wet- and dry-mantle flood periods have inflicted damage in this sub-basin. These include the winter wet-mantle floods of 1875, 1884, 1890, 1907, 1910, 1914, 1943, and 1952. The dry-mantle floods of note, following 1874, were July 1876, August 1878, June 1882, June 1884, August 1884, August 1890, July 1913, June 1918, and June 1961.

The total area occupied by all range phreatophytes is approximately 115,000 acres (natural stand densities and species composition). Black greasewood, rubber rabbitbrush, smallflower tamarisk, saltgrass, and alkali seepweed are the principal phreatophytes present.

Despite the fact that the major cover type is shadscale-bud sagebrush, fire is an

omnipresent threat to the higher watershed lands with a more inflammable vegetal cover. There have been disastrous fires causing livestock losses as well as removal of vegetation on these watershed lands, particularly in the northern portion of the sub-basin.

Little has been done in the way of outdoor recreation facilities development; however, there is a considerable potential for such development in the Humboldt Range and East Range.

Rye Patch Reservoir provides the major recreation area at the present time, with fishing, swimming, and boating making up the principal activities.

There is only a limited amount of big game hunting in the sub-basin, but chukar partridge, pheasants and other upland birds offer many days of small game hunting in the fall.

Regular Department of Agriculture and other Federal and State programs can provide assistance in accomplishing many needed improvements in the sub-basin. The regular programs of the Bureau of Land Management, including fire protection, provide for the protection and improvement of the Federal lands that agency administers, within the scope of currently available funds.

A review of the sub-basin indicates the water and related land resource problems in Lovelock Valley Watershed can best be handled on a project basis. In this area, improvement measures can be installed which will provide for flood prevention, watershed protection, reduce erosion and sediment damage, and increase forage production on crops and range lands. A preliminary evaluation of the works of improvement proposed for the watershed area is sufficiently favorable to warrant a more detailed study of the possibility of a watershed protection and flood prevention project.

HUMBOLDT RIVER BASIN SURVEY

LOVELOCK SUB-BASIN REPORT

AUTHORITY AND ORGANIZATION

The need for continually improving the conservation and use of water and related land resources has long been recognized by Federal, State, and local agencies. A pertinent development of this continuing interest is River Basin studies under Section 6 of Public Law 566, as amended and supplemented. In Nevada such a survey is underway by the U.S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources.

The Secretary of Agriculture is authorized under the provisions of Section 6 of the Watershed Protection and Flood Prevention Act to cooperate with other Federal and with State and local agencies in making investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs.

General direction for the U.S. Department of Agriculture in the conduct of the studies and preparation of the report was provided by a USDA Field Advisory Committee composed of representatives of the Soil Conservation Service, Forest Service, and Economic Research Service. The USDA River Basin Representative served as advisor and consultant to the committee.

General direction for the State of Nevada was provided by the Director of the State Department of Conservation and Natural Resources.

A Field Party, composed of representatives of the Soil Conservation Service, Forest Service, and Economic Research Service, completed the field work and prepared this report.

Grateful acknowledgement is made to all individuals and to the personnel of other State and Federal agencies who gave their counsel and technical assistance in the preparation of this report.

HISTORICAL INFORMATION

Settlement

This sub-basin, which might be considered the gateway to the Humboldt Basin, was also the first to be exploited by the white man on a more or less sustained basis, following the period of initial exploration and use by British and American fur-trappers throughout the Humboldt Basin.

The first advent of the white man into the Lovelock Sub-Basin occurred November 11, 1828. Peter Skene Ogden, brigade leader for the Hudson's Bay Fur Company, on the fifth of his Snake Country Expeditions, and the sixth under the direction of the Company, entered the main Humboldt Valley from the Little Humboldt, just above modern Winnemucca, on November 9. He trapped beaver along the Humboldt in the Winnemucca vicinity on November 9 and 10, and then on November 11 entered the sub-basin when he proceeded downstream to the vicinity of present Mill City.

However, because of the lateness of the season, Ogden reversed his course and traveled up the Humboldt, as detailed in other sub-basin reports of this series, enroute to

his winter quarters in the Wasatch Range east of present Ogden, Utah.

On his return trip down the Humboldt in the spring of 1829 Ogden reached the upper boundary of the Lovelock Sub-Basin at Rose Creek on May 8. From May 8 to May 29 he trapped the lower Humboldt to its terminus in the sloughs and lakes below present Lovelock, camping on the shore of Humboldt Lake itself May 29. Because of the swampy, sloughy nature of the river in this vicinity, he considered changing his first names for the stream - Unknown River, or Paul's River - to Swampy River, according to Dr. Gloria G. Cline, foremost American authority on Ogden.

Although apprised by the Shoshones at this time of the existence of the Truckee River several days' journey to the west, Ogden proceeded no farther in that direction. On June 4, 1829, he began retracing his route up the Humboldt to the Little Humboldt, and thence up that stream, leaving the Humboldt Basin at Paradise Hill Pass and crossing over to Quinn River on June 11, 1829.

On his sixth and last Snake Country Expedition, late in 1829, - the definite dates are unknown, because Ogden's journals and maps for this expedition were later lost in a boating accident on the Columbia River - Ogden retraced his route to the Humboldt Sink. However, he was unable to trap along the Humboldt, as it was frozen over. From the Humboldt lakes the expedition left the Humboldt Basin for the last time, striking southwestward to the Humboldt-Carson Sink, then to Walker River, and thence into California.

Ogden's Humboldt Basin travels are of great importance, not only because he and his men were the first whites to see the Humboldt, and trace it "from its source to its sink", as Dr. Cline puts it, but also because Ogden produced the first true map of the Humboldt Basin. Ogden was also the first to set down written descriptions of northern and central Nevada. Through the instrumentality of the Snake River Expeditions, Ogden and his successor, John Work, disproved the existence of the mythical Buenaventura River which, it had been assumed, flowed from Sevier Lake to the Pacific Ocean at San Francisco Bay. It would be almost 20 years, however, before this fact became commonly known - except to the mountain men - by Americans in general.

Only one American fur-trapping group, the well-led but untimely and abortive venture of Captain Benjamin Bonneville's 1833-1834 party of trappers, led by mountain man Joseph Walker, was of any historical note in the Lovelock Sub-Basin. Its significance was of a negative rather than a positive nature, however. The results and aftereffects of its two massacres of Paiute Indians near Humboldt and Toulon Lakes, the first on its westbound trip along the Humboldt to California in October 1833, and the second on the return leg of the journey in June 1834, enroute to the Bear River rendezvous with Captain Bonneville, were long-lasting.

Walker, as a result of these first two large-scale battles between the red man and the whites in Nevada, named present Toulon Lake and Humboldt Lake Battle Lakes. The Humboldt River he named Barren River, because of the absence of tree growth along its banks.

The emigration period along the California Trail started with the Bidwell-Bartlesons in 1841. The main track of the trail threaded the entire length of the Lovelock Sub-Basin following along the west bank of the Humboldt, from Rose Creek to the Lovelock sloughs and meadows, which were known as Big Meadows to the emigrants (see photograph 1). Here the emigrants halted for a last-chance rest, recuperation and refitting period in the green, well-watered ryegrass meadows, preparatory to tackling the terrors of the "dry

Photograph 1. - These deep ruts twisting across the benchlands west of the Humboldt River between Rye Patch and Oreana bear mute but graphic testimony of the thousands of covered wagons which rolled westward along this portion of the California Emigrant Trail from 1843 to the 1870's. They also bespeak the mule-drawn mail and express wagons of the Chorpenning mail route in the 1850's which used this route. The Concord 'mud wagons' of Hill Beachey's Railroad Stage Lines plied this trace in the 1860's, loaded to the guards with fortune-hunters from California or the Comstock mines, bound either for the Humboldt silver mines or the southwest Idaho goldfields. (Looking northeast, toward the north extremity of the Humboldt Range.) FIELD PARTY PHOTO

Photograph 2. - Decaying ruins of Humboldt City, in the Humboldt Range east of Humboldt House. This site was the scene of hectic activity in the Humboldt silver boom of the early 1860's which was the first large-scale mining development in central and eastern Nevada. As such, the ruins are worthy of marking and preservation as a historic site. FIELD PARTY PHOTO 6-867-5

drive" across the Forty Mile Desert.

The tide of emigration did not set in until 1843, however, with the advent of the Chiles Party, guided by Joe Walker, following his 1834 Bonneville fur party route. The flow of emigrants did not reach its height until the onrush of the "Golden Army" of 1849. It continued almost unabated all during the 1850's, tapering off in the 1860's, and dwindling to a trickle in the 1870's, after the joining of the Central Pacific and Union Pacific Railroads at Promontary, Utah in May 1869.

One other important branch of the California Emigrant Trail, the Applegate-Lassen Trail, left the main Fort Hall Route west of Imlay. From this junction in upper Lassen or Rye Patch Meadows, now usually covered by the waters of Rye Patch Reservoir, the Applegate-Lassen Cutoff proceeded in a westerly direction up Willow Springs Canyon, to the springs themselves, and thence over the Antelope and Kamma Ranges to the Black Rock Desert by way of Rosebud Canyon.

The Lovelock Sub-Basin is literally studded and pock-marked with weathered mine-dumps, decaying headframes, abandoned shafts, caved-in tunnels, and ghost mining camps, all remnants of the many once busy but mostly short-lived mining ventures of the past. The earliest mining in the Humboldt Basin, and, along with the Esmeralda discoveries, the earliest in Nevada after the Comstock lode, took place here.

Mining activity in the sub-basin got off to a fast start with the discovery of the silver mines at Humboldt City, Star City, and Unionville in 1860-1861, the mines at Dun Glen in 1862, and the ensuing "rush to Humboldt" (see photograph 2). In the succeeding years, one mining enterprise after another shone brightly but briefly, then faded from the scene. Since revival of mining in Nevada following the Tonopah-Goldfield boom at the turn of the century, the principal mineral and metal producers in the sub-basin have been the Rochester gold mines, the Nevada-Massachusetts Tungsten operations west of Mill City, the Eagle-Picher diatomaceous earth processing mill at Colado, the Toulon Tungsten Mill, and the U.S. Gypsum Company's perlite mine, with its mill a few miles north of Lovelock. Presently, mining of nonprecious metals makes up a significant segment of the Pershing County economy.

Railroads became a factor in the history of the Lovelock Sub-Basin when the Central Pacific Railroad's gangs of indentured Chinese laborers laid its rails across the White Plains Summit and down into the Humboldt-Carson Sink in July 1868. The site of present Lovelock was reached early in August 1868. In exchange for George Lovelock's donation of approximately 80 acres of land for a station site and trackside facilities, the Central Pacific named the new station Lovelock's, in honor of the donor (see photograph 3). It quickly became the point of departure for the booming mining camps of Arabia and Trinity in the Trinity Range to the north.

The track gangs, taking advantage of the easy going along the Humboldt from Brown's Station (Toy) eastward, were beginning to hit their stride, laying from three to four miles of track in two eight-hour shifts, according to Myrick. On August 19, between Oreana and Mill City eight miles of rail were laid between sunup and sundown.

The rails were laid to Mill City by August 29, and passenger service had been extended to there by the first week of September 1868. The Humboldt Register announced that the end of track would reach Winnemucca by the evening of September 12. However, according to Myrick, the rails actually reached Winnemucca at 10:00 AM on September 16, where the tracklayers used up the last of the supply of rails and ties then on hand.

Photograph 3. - West Broadway, Lovelock, about 1912. By the time of this photograph, Lovelock - first known as Lovelock's Station on the Central Pacific, later shortened to Lovelock's, and finally Lovelock - had become the center of an increasingly important agricultural area. LAWRENCE STIFF PHOTO

Photograph 4. - Buildings and grounds at Humboldt House, looking southwest down the Central Pacific (Southern Pacific) main line. When this photograph was taken about 1907, dining car service on all Southern Pacific passenger trains, introduced about 1899, had eliminated all station meal stops such as this. However, the restful shade and well-kept buildings and grounds of this desert oasis which so beguiled early transcontinental railroad travelers were still very much in evidence at that time. ROY MILLS PHOTO

After the old Central Pacific Railroad in August 1899 came under the full ownership of its offspring, the Southern Pacific Railroad, the new corporate title of the old transcontinental line became Central Pacific Railway, although it was generally known as the Southern Pacific. To shorten the line and speed up and improve rail service, in the fall of 1899 engineers and surveyors scattered across Nevada, laying out line changes in the original Central Pacific alignment, practically unchanged since its construction, except for a few localized areas farther up the Humboldt, such as short sections in Carlin (Fremont) Canyon and Palisade (Twelve-Mile) Canyon. During the period 1901-1903, most of these line changes were completed across Nevada.

With the completion of the Lucin Cutoff across Great Salt Lake in 1904, there was a general shifting and rearrangement of engine and crew terminals and division points along the old Central Pacific main line. In the sub-basin, the division terminal and roundhouse formerly located at Winnemucca were moved to Imlay, and that small whistle-stop became a busy, bustling engine terminal and freight division point. However, since the replacement of steam locomotives by diesel power, starting in the early 1950's, Imlay has slowly reverted to its former status; it is once more just another desert hamlet along the Humboldt.

Humboldt House, or Humboldt Station, originally the point of departure in the late 1860's for Humboldt City, Prince Royal, and the mines in that vicinity, became noted far and wide in the period from 1869 to the turn of the century as one of the best eating houses and dining rooms along the old Central Pacific. During this 30-year period, Humboldt House became literally an oasis in the desert. Water, piped from Humboldt Canyon to the east in the Humboldt Range for locomotive use, was also used to irrigate 30 acres of peach, apricot, pear and apple trees, which were all heavy producers of fine fruit. In addition, gooseberries, strawberries, currants, and blackberries, along with lilacs, roses, and other flowering shrubs grew "as if to the manor born", as Thompson & West phrased it in their somewhat rococo prose. Eight acres of alfalfa, among the earliest planted to this forage crop in the Humboldt Basin, yielded several cuttings annually, and a large kitchen garden furnished in season all the vegetables needed for the railroad dining room. (See photograph 4.)

Today, about all that remains of this formerly well-known tarrying place on the old Central Pacific is a few decayed and abandoned railroad structures, scattered through the remnants of the once-flourishing grove of shade trees.

The most ambitious short-line railroad project in the sub-basin, and the only one to ever reach fruition, was the 12-mile narrow gage Nevada Short Line, originally projected by A. A. Codd, one of the principal mine owners at Rochester. This line operated from 1913 to 1918 between Oreana on the Southern Pacific and the mines and mill at Rochester.

The beginnings of the present U.S. Highway 40 - Interstate Highway 80 transcontinental highway complex through the sub-basin started in the early years of the Twentieth Century. So far as is known, the much-publicized attempt of a Winton car in 1901 to travel coast to coast across the United States was the first effort at through auto travel in the Humboldt Basin. Following the old emigrant road westward down the Humboldt, the Winton came to grief and terminated its run in the sand dunes along the Humboldt between Winnemucca and Mill City.

In June 1903, a group of automobilists from San Francisco came up the Humboldt from the west. They avoided the Winton's sand trap by taking the long-unused stage and

freight bypass road over the East Range via Dun Glen and Dun Glen Canyon. They reached Winnemucca on June 21, 1903, and Elko the evening of June 23. It is interesting to note here that this Winnemucca-Elko stretch of road, requiring two full days of arduous travel by these pioneer automobilists, can now be negotiated in two and one-half hours or less on U.S. Highway 40 - Interstate 80.

The first concerted attempt to develop an automobile highway system along the Humboldt did not come about until 1916. By the act of July 11, 1916, Congress provided Federal aid to States in the construction of rural post roads. Following this, in March 1917 the Nevada Legislature created the Nevada Department of Highways. By 1927, construction was completed on the Victory Highway through Nevada and over Donner Pass in California by way of the new 1925-1926 section through upper Truckee Canyon between Verdi, Nevada and Truckee, California (see photograph 5). To celebrate the completion, the Nevada Transcontinental Exposition was held in Reno during the summer of 1926. By 1931, the Nevada Federal highway system, as originally set up and designated in 1917, was completed and gravel-surfaced.

Photograph 5 - One of the earliest service stations along the Victory Highway (now U.S. Highway 40) in central and western Nevada. The first Stiff station, shown here not long after its opening in Lovelock March 15, 1923, it was located two blocks south of the present Two Stiffs Motel and Service Station.

LAWRENCE STIFF PHOTO

Early in Governor Balzar's administration, (1927-1934) oil-surfacing was started along U.S. Highway 40, and completed during that time. At the time this oil surfacing was done south and west of Lovelock, the old Victory Highway routing from just east of Toy to the Brady Hot Springs on the abandoned grade of the Central Pacific was changed to its present alignment. Further widening and relocation work was carried out along U.S. 40 in the early and late 1940's. In 1960-1961 the first piece of freeway in the Interstate 80 system within the sub-basin was completed, from the Woolsey Hill overpass to Imlay. In 1962-1963 the next link in Interstate 80 in the sub-basin was added, from Toy to Brady Hot Springs over Brown's Hill and the White Plains Summit.

The history of the agricultural industry in the Lovelock Sub-Basin, which has been its economic mainstay since the 1890's, has been long and varied. Agriculture, primarily the raising of irrigated crops, is perhaps more advanced in the Lovelock Valley than anywhere along the Humboldt. This valley has well earned its sobriquet, Nevada's Valley of the Nile, and the difficult, involved and hitherto largely untold story of its irrigation development, along with the various irrigation systems and the men who put them together, make interesting reading.

The first permanent settlers in the Lovelock Valley, the Big Meadows of the California pioneers, were James Blake and his brother, who in April 1861 located 320 acres on what later became known as the Lovelock Slough, according to Thompson & West and Scrugham.

In 1866 Mr. Lovelock bought out the Blake brothers' holdings, and undoubtedly operated their establishment as a stage station on Hill Beachey's line from that time until the arrival of the Central Pacific Railroad in July 1868. So far as may be determined, the Blakes and Lovelock in 1866 completed one of the earliest irrigation canals in the Lovelock Valley. They harvested the Great Basin wildrye growing in the meadows and along Lovelock Slough with scythes each fall, and used or sold the hay. The L. N. Carpenter priority in the Union Canal is based upon this early Blake-Lovelock water right.

Outside the Blake-Lovelock settlement, which, as noted, was at the site of present Lovelock, the general settlement and agricultural use of the Lovelock Valley started in the lower valley, from present Lovelock south to the Humboldt lakes. According to existing historical records and the accounts of early settlers, this lower valley area came into agricultural cultivation and irrigation use about 15 years before such use started in the portion above Lovelock.

Here it was that J. B. ("Poker") Brown in 1862-1863 dug a mile-long ditch connecting the Lovelock Slough above present Lovelock with the Lowery Slough, which meandered southward from Lovelock toward the lakes. He used this water on what later became a part of the L. N. Carpenter Ranch, now a portion of the Cord Circle L Ranch. These 1863 Brown water rights are now incorporated in the Rogers Canal system. Therefore, the Rogers Canal may be said to have carried, prior to the construction of Rye Patch Reservoir, the oldest rights to Humboldt River waters in Lovelock Valley itself. (When Rye Patch Reservoir was put into use, its waters were allocated on an acreage basis to all Pershing County Water Conservation District participants.) However, the earliest irrigation in the sub-basin, and by the same token in the entire Humboldt Basin, based on established priorities, was in 1861 by J. A. Callahan, of the old Callahan Ranch in the Lassen Meadows west of Imlay. These water rights were in later years transferred to the Southwest Ditch and Irish-American Canal in the Lovelock Valley.

Poker Brown, according to a letter written about 1888 and reprinted in the September 24, 1964 issue of the Lovelock Review-Miner, was the only early rancher who act-

ually had permission from the Utica Bullion Mining Company to use the waters of the lower Humboldt. This mining Company laid claim, under the so-called "Humboldt Right" of August 20, 1864, to all the waters of the Humboldt, and in particular those of the lower Humboldt. After the mining company's quartz mill dam across the drain through the natural dike below the Humboldt lakes was blown up in June 1884 by a party of masked men (see Flood Damage), its claim to the Humboldt waters seemingly collapsed. The letter states that in the late 1880's the Utica group tried to sell their so-called "Humboldt Right" to the Lovelock Development Company, but were not successful in so doing.

In the early 1870's agricultural development of the lower valley started in earnest with a large influx of settlers, mostly of northern European origin, via the California gold fields and lumbering and mining operations on the Comstock Lode. As with the Carson Valley in western Nevada, many of these were of Danish (Marker, Anker, etc.), German (Marzen) or Swedish (Larsen) descent. Most of them in later years were numbered among the largest operators in the Lovelock Valley.

Other early settlers in the lower valley were Henry Larsen, Hans Jensen and Andrew Westfall. Mr. Westfall, along with Marker, Marzen, and others, was involved in the construction of the Marker diversion dam in 1876, the first of the present six diversions on the Humboldt in Lovelock Valley. After the Lakeshore, Reed, and Fuss ditches in the lower valley were combined following the 1890 floods into the Union Ditch Company, Mr. Westfall became its first president. (Present Union Canal Ditch Company.) His holdings are now included in the Robert Gottschalk Ranch.

Peter N. Marker, who became one of the big ranchers in lower Lovelock Valley, along with Joseph Marzen, John H. Theis, L. N. Carpenter, and John Fant, made his first purchase of land in the lower valley in 1872. He kept adding to his acreage, until he owned 12,800 acres in the lower valley and an additional acreage in the upper valley. His lower valley holdings were known as the Reservation Ranch; this ranch later made up a large portion of the Rogers Ranch and is now included in E. L. Cord's Circle L and Nevada Nile Ranches. Mr. Marker led the way in tree planting in the valley, teaming in hundreds of small cottonwoods in the 1870's from the Stillwater area on the lower Carson River.

Colonel Joseph Marzen settled in the upper part of the lower Lovelock Valley in 1877, and established his famous Humboldt Stock Farm. At this time, he developed the Southwest Ditch - sometimes referred to as the Marzen ditch - and still in use for irrigation. In 1880, Thompson & West credited him and Marker with being the two largest irrigators and cattle-raisers in the entire Big Meadows area. Colonel Marzen is said to have been the first rancher to introduce alfalfa into the Lovelock Valley and the Humboldt Basin. He and Peter Marker were the principal builders of the Marker and Marzen diversions on the Humboldt, the first of such structures to be built in the valley.

Scrugham notes that in January 1877 Marzen engaged his countryman Peter Anker to build what was then the largest barn in the State of Nevada. Mr. Anker subsequently became known as perhaps the best builder and construction man along the lower Humboldt, as well as being one of the better ranchers, with some of the best alfalfa in northern Nevada. He built the first county bridge over the Humboldt to the Theis (Riverside) Ranch, below the present structure, laid the foundations for the original Big Meadows Hotel, and built over 20 houses in Lovelock.

Later ranchers of note in the lower Lovelock Valley were H. W. Fuss, Henry Killebrew, and C. C. Carpenter. Henry Killebrew homesteaded 160 acres of land in the lower valley in the late 1880's, and when these lands were flooded in the spring of 1890,

put up a levee along its east side to keep the Humboldt River away. When Killebrew and C. C. Carpenter, Killebrew's brother-in-law and son of L. N. Carpenter, collaborated in construction of the Big Five Dam, 1899-1901, they used the levee as a portion of the new eight-mile levee structure. In 1935, C. C. Carpenter became president of the Union Canal Ditch Company, which included the Lakeshore Ditch his father, L. N. Carpenter, had constructed in 1875 to irrigate their holdings from the Lowery Slough.

Mr. Fuss came to the Lovelock Valley in the early 1870's, and purchased a section of land in the upper portion of the lower valley. He was one of the first to tap the Lowery Slough for irrigation below Lovelock. In the 1890's he joined Mr. Westfall's Union Ditch Company, and in the early 1900's began irrigating through this ditch system, which then emanated from the now-defunct Union diversion dam.

From the time of the first cultivation in the lower valley until the construction of the Young diversion dam in 1888 and the Pitt Dam about the same time in the upper valley, the lower valley was the agricultural mainstay of the entire Big Meadows area. Its grain and alfalfa crops were far richer than those of the upper valley. (Wheat was the first grain crop grown; the first wheat was harvested by William Silverwood, one of the lower valley pioneers, about 1879. It is known that he raised 10 acres of wheat that year, primarily to feed his large number of hogs (300), the raising of which he also pioneered in the Lovelock Valley, according to the 1911 Tribune article.)

As the upper valley became more settled and cultivated, its irrigation tail waters draining into the lower valley kept the soils there saturated, making them more saline and less productive. Only a certain amount of this excess water could be drained away by means of the natural channel through the Humboldt dike. As a result, until the Army, Toulon and other drains were dredged at the lower end of Lovelock Valley beginning in 1915, and the natural channel through the dike deepened, the lower valley production continued to lag.

The men most responsible for the development of irrigation and cultivated crops in the upper valley were William C. Pitt, Stephen R. Young, L. H. Taylor, an irrigation engineer, and sheepman John G. Taylor. Efforts toward bettering the upper valley's agricultural production started with the construction of the Young Dam and Canal at Woolsey in 1888.

The era of organized irrigation in Lovelock Valley from large permanent diversion structures in the Humboldt River and ancillary canal systems began in the summer of 1876, with the construction of the Marker diversion in the upper valley east of Lovelock (see photograph 6). This first diversion was built to supply the irrigation water lost to Peter Marker when the Lovelock and Lowery Sloughs, which supplied a natural irrigation water source, were drained with the washout of the Utica Bullion Mining Company's dam below the Humboldt lakes (see 1876 wet-mantle flood discussion in Flood Damage).

About a year after the construction of the Marker diversion, Joseph Marzen built his Marzen (sometimes referred to as the Marzen and Morrison) diversion. Mr. Marzen built the structure to supply his Southwest Ditch with water following the draining of Lovelock Valley's natural sloughs and the Humboldt lakes when the Utica Bullion Mining Company's dam was washed away. The structure was located on the Humboldt just below the present Irish-American diversion.

As noted in the Flood Damage section of this report, the Marzen structure was seriously damaged in the 1884 wet-mantle floods, but was rebuilt and strengthened that fall. It was again damaged in the 1890 floods, but not washed out. However, along with the

Photograph 6. - Ruins of the Marker Dam, the first large diversion on the Humboldt River. It was constructed in 1876 and finally abandoned after the 1890 wet-mantle floods in favor of the Rogers diversion just upstream, from which structure this photograph was made. FIELD PARTY PHOTO

Photograph 7. - Rogers Diversion on the Humboldt River, Lovelock Valley, looking upstream toward the Humboldt and West Humboldt Ranges. Constructed to replace the Marker diversion after the 1890 floods, it is now one of the principal diversion structures in the Pershing County Water Conservation District's water distribution system in Lovelock Valley. FIELD PARTY PHOTO

other permanent diversions in the valley, the structure was destroyed in 1910. It was not rebuilt; since that time the Southwest Ditch has taken its water from the Pitt Diversion via the Union Canal.

The Irish-American dam northeast of Lovelock was constructed in 1887. It derived its name from the nationalities of the group of men involved in its building, and is sometimes called the Last Chance Dam because it was built at the last good dam site on the Humboldt in the immediate vicinity of Lovelock, at the old Hill Beachey stage road ford on the river.

This construction was followed in the fall of 1888 by the erection of the Young Dam at Woolsey, which irrigated the upper valley through the Old Channel and the Young Ditch, and generated the first electricity in Lovelock Valley.

That same year the Pitt (Pitt & Hauskins) dam was built just north of Lovelock in the upper valley. William C. Pitt and associates built the original Pitt Flour Mill at this location in 1895, powered at first by water from the dam, and subsequently by electricity generated there. In 1911 the mill was moved to downtown Lovelock, where it remained until its destruction by fire in September 1964. In 1918 the company assumed its present name, Pitt Mill & Elevator Company.

The Union Diversion Dam, now long gone and almost forgotten, was, nevertheless, one of the important early large diversions in lower Lovelock Valley. It was constructed on the Humboldt in the lower valley in the late 1890's about three miles below the present Rogers Diversion. The builder was the Union Ditch Company, formed by Alfred Westfall, H. W. Fuss, and other lower valley ranchers to manage their newly combined Lakeshore, Reed, and Fuss ditch system - hence the name Union Ditch Company and Union Diversion.

The structure was washed away by the 1910 wet-mantle floods and was not rebuilt. Arrangements were then made to take water from the Pitt Diversion in the upper valley to the Union Ditch Company's system in the lower valley via a new canal (Union Canal) and the Rogers (formerly Marker) Canal.

Following these changes, the Union Ditch Company became the Union Canal Ditch Company. The combined Union-Rogers Canal and their tributary ditches presently irrigate most of the land in the lower valley not under the Sommer(s), Big Five, and Seventeen Ditches.

After the Marker dam washed out in the wet-mantle flood of 1890, it was replaced about 100 yards upstream by the Rogers Dam, which supplies water to the Rogers and Union-Rogers Canals (see photograph 7). The Rogers Dam is located a short distance below the Irish-American structure in the Humboldt River; it washed out in 1942, and was rebuilt in 1946.

The Big Five Dam and Reservoir in the lower valley, the lowest of the present six diversion structures in Lovelock Valley, was started in 1899 and completed in 1901. Named from Henry Theis, Hi Stoker, U.S. Senator George Nixon, Warren Noteware, and F. M. Lee, the five men associated in its development, it was hailed at the time of its completion as the largest irrigation structure in the State of Nevada. By means of its dam and the old Killebrew levee along the west bank of the Humboldt River, a 4,800 acre-feet capacity lake about two miles long and one mile wide was impounded, which furnished water for the Big Five Ditch. Total construction costs amounted to $25,000.

Around 1932 the original Big Five structure washed out. It was partially replaced by the present levee extending eastward across the Humboldt channel, to aid in delivering water to the Big Five ditch. In 1945 the diversion spillway washed out, and was replaced early in 1946 with the present concrete spillway. At the same time over two and one-half miles of levee along the west side of the Humboldt River were raised and strengthened.

About 1917, the Sommer (now usually written Sommers) Diversion was constructed in the Humboldt channel about two miles above the Big Five Diversion, and is still in use, serving the Sommers ditch in the lower Lovelock Valley.

Water storage projects developed by Lovelock Valley interests on the Humboldt River above the valley began in 1910 with institution of work on the Pitt-Taylor Dams and Reservoirs, with a diversion and canal leading from the river about two miles above Mill City. William C. Pitt, prominent upper valley rancher, and John G. Taylor, upper valley farmer and for many years Nevada's largest sheep rancher, were the principal movers of this enterprise, under the corporate name of Humboldt-Lovelock Irrigation, Light and Power Company, with L. H. Taylor as the irrigation engineer in charge of construction. The work was completed in 1913.

Drainage District Number 1 was formed in 1915, to drain the lower valley. Construction was then begun on about 30 miles of open drains, including the deepening of the natural channel through the Humboldt dike. Presently, there are about 128 miles of these drains in Lovelock Valley.

In 1926, during the drouth years of the 1920's, the Lovelock Irrigation District was formed, for the purpose of constructing a dam at Oreana. However, after the expenditure of approximately $100,000 for engineering and legal services, the proposed Oreana structure was not built, as it was determined the site would not furnish sufficient storage capacity to warrant its installation. In February 1929 the district's name was changed to its present title, Pershing County Water Conservation District, and work was begun in 1935 by the U.S. Bureau of Reclamation on the Rye Patch Dam. The dam was completed in the fall of 1936, and irrigation water from Rye Patch began to be distributed in Lovelock Valley through the six diversion structures there (see cover photograph). In connection with this project, the district from 1935 to 1939 acquired lands with appurtenant water rights in the Battle Mountain basin, as well as the Pitt Ranch in upper Lovelock Valley, and the accompanying controlling interest in the Pitt-Taylor Reservoir. The Pitt Ranch was subsequently sold at auction in 1941, and the major portion is presently owned by the Lucky Livestock Company. In 1953 the district took over the ownership and operation of Drainage District Number 1.

The first organized effort toward the conservation and management of the soil, vegetal, and water resources of the sub-basin began in 1935. At that time, under the provisions of the Taylor Grazing Act, the Winnemucca Grazing District was established, and administered by the Division of Grazing - now the Bureau of Land Management - in the Department of the Interior, to manage the public domain lands.

Portions of four soil conservation districts lie within the confines of the sub-basin: The Big Meadow, organized August 1954; Quinn River, October 1955; Sonoma, February 1954; and Stillwater, July 1948. The major portion of the sub-basin is included in the Big Meadow District, covering all of the cropland.

Photograph 8. - Severe wind erosion area resulting from the 1963 Raspberry Fire. Wind action on the denuded soils of the burn area has resulted in loss of much of the topsoil here; the only vegetal growth now present, as seen in the photograph, is Russian thistle. (Looking southwest, toward the Eugene Mountains.)

FIELD PARTY PHOTO 6-867-2

Floods

The Lovelock Sub-Basin has been subjected to recurrent periods of flooding and high water. The earliest recorded flood year along the Humboldt main stem was December 1861-January 1862. However, since this flood occurred just prior to the beginning of population buildup in or near the Lovelock Sub-Basin, there are no known records of damage.

For further information on the history of floods and high water periods in the sub-basin, the reader is referred to the section on flood damage.

Fires

The Lovelock Sub-Basin has suffered perhaps the least of all in the Humboldt Basin from range and watershed fire damage. Undoubtedly this is because much of the vegetal cover, particularly in the lower one-third of the sub-basin, is composed of more fire-resistant species, such as greasewood, shadscale, and rabbitbrush, or because the vegetal cover is generally too widely scattered to allow wildfire to carry well.

Wildfires have been more frequent in the upper half of the sub-basin, where thicker-growing and more inflammable grass, shrub and tree species occur. The latest and most significant fire, from the standpoint of range and watershed damage, was the 5,500-acre man-caused Raspberry Fire of late July 1963. This fire, which started along U.S. Highway 40 west of Rose Creek, has three-fourths of its burned area in the Lovelock Sub-Basin, and one-fourth in the adjoining Sonoma Sub-Basin. Following the fire, a severe wind-erosion area developed in the burn along U.S. Highway 40 which is still largely unarrested, primarily because of marginal or sub-marginal revegetation possibilities. Dust and sand blown from the denuded area have periodically created a severe visibility hazard to traffic along the heavily-used highway. (See photograph 8.)

POPULATION

Lovelock is the principal supply center for the people in the Lovelock Sub-Basin. This city has been steadily increasing in population. Pershing County has generally followed an upward trend in population also, as indicated in the following tabulation.

	1930	1940	1950	1960
City of Lovelock	1,263	1,294	1,604	1,948
Pershing County	2,652	2,713	3,103	3,199

PREVIOUS STUDIES

Bureau of Reclamation

A land and water resources study was made by the Bureau of Reclamation prior to the construction of Rye Patch Reservoir. The project plan provided for the construction of Rye Patch Dam and Reservoir, and the acquirement of lands and water rights in the Battle Mountain area.

Additional studies by the Bureau resulted in the development of a plan, published in 1952, to improve the operation efficiency of the Humboldt Project. This plan provides for drainage, flood control, and improvement of the primary distribution systems for the project lands.

Corps of Engineers

The Corps of Engineers developed plans and constructed flood control dikes for lower Lovelock Valley in 1945 and in 1952. These measures provided protection to project lands from the high water of the Humboldt lakes, and for the installation of pumps to discharge drainage water into the lakes.

U.S. Geological Survey

Ground water studies have been made in Lovelock Valley and in the Imlay area by the U.S. Geological Survey in cooperation with the State Department of Conservation and Natural Resources (Water Resources Bulletin No. 2, and Ground Water Resources - Reconnaissance Series, Report 5, respectively).

Other Studies

Other technical reports covering limited or specialized fields have been made at various times in the sub-basin. Their titles are listed in the References section of this report.

GENERAL SUB-BASIN CHARACTERISTICS

The Lovelock Sub-Basin is in the southwest part of the Humboldt Basin. It lies as a relatively narrow strip, approximately 80 miles long and 15 to 20 miles wide, along the Humboldt River, between Rose Creek Gaging Station and the natural dike below Toulon and Humboldt Lakes. The sub-basin contains about 1,048,000 acres, lying mostly in Pershing County, but a small area on the north end is in Humboldt County, and the southern tip is in Churchill County.

The Trinity and Antelope Ranges and the Eugene Mountains form the west boundary of the sub-basin. They have crest elevations of about 5,500 feet, with peaks ranging to 7,580 feet. The West Humboldt and Humboldt Ranges, and the northern part of the East Range, form the east boundary. The West Humboldt Range crests at about 6,000 feet, and has peaks ranging to 6,349 feet; the Humboldt Range crests at about 8,000 feet, with peaks ranging to 9,834 feet (Star Peak); the East Range crests at over 6,000 feet, with

peaks ranging to 7,441 (Dun Glen Peak).

A low ridge or dike about 60 feet high forms the southern boundary of the sub-basin. A gap in this natural dike was deepened in 1915, to prevent the Humboldt lakes from rising and flooding irrigated land in lower Lovelock Valley.

Geology

The Lovelock Sub-Basin is situated in the northwestern part of the Great Basin Section of the Basin and Range Physiographic Province. Terrain in this sub-basin may be divided into steeply sloping dissected mountain highlands, more gently sloping intermediate alluvial slopes, and relatively flat valley floors and flood plains. At least a few river terrace remnants occur along the flood plain of the Humboldt River above Rye Patch Reservoir.

Extensively folded and faulted consolidated rocks of Paleozoic and Mesozoic ages are exposed in highland areas. Included are rhyolitic tuffs, breccias, flows, altered volcanic rocks, limestone, dolomite, shaly limestone, calcareous shale, conglomerate, sandstone, siltstone, slate, and phyllite. Intrusive rocks occurring in the highland areas include granodiorite, quartz monzonite, rhyolite porphyry, diabase, and aplite (see photograph 9). They are exposed at scattered locations. Younger volcanic rocks of Cenozoic age occur overlying older consolidated, metamorphic, and intrusive rocks. These rocks include rhyolitic flows and tuffs, and later basaltic lavas.

The intermediate slopes which lie between the highlands and valley floors consist of alluvial fans and lake terraces. Generally, the intermediate slopes are steepest near the mountain fronts, and flatten to merge with nearly flat former lake plains which form a major portion of the present valley floors in the sub-basin. Some alluvial fans encroach upon lower erosional surfaces, such as lake-associated surfaces and terraces at different localities.

Often older eroding or degrading alluvial fan surfaces are exposed along the upper portion of the intermediate slopes, while younger aggrading alluvial fans occur mostly along the lower portion of the slopes. Very old alluvial fans, which may have been uplifted with the mountain blocks, occur along the flank of the East and Humboldt Ranges.

The terraces are shore line features that were cut or built by ancient lakes which covered much of the area during Quaternary time (see photograph 10). Lake Lahontan inundated the sub-basin to a maximum elevation of about 4,380 feet. Alluvial fans which encroach upon terraces may consist of alluvium eroded from terrace materials, or alluvium derived from both terrace and highland slopes. Locally, tuffa-encrusted bedrock prominences or mounds protrude above the surface of the ground.

Deposits in the valley lowlands include beach and other lake-associated accumulations, as well as stream and aeolian deposits. Colluvial deposits occur along the base of fault and terrace scarps and steep slopes underlain by bedrock.

The Humboldt River is entrenched from about 50 to nearly 200 feet in principally lacustrine and associated alluvial deposits. This downcutting is particularly noticable in the area south from Imlay, and may have been caused by the withdrawal of Lake Lahontan and a consequent lowering of base level.

South of Lovelock the river drains into Humboldt and Toulon Lakes, which are

Photograph 9. - Intrusive rocks in the highland area at the head of Humboldt Canyon, Humboldt Range. FIELD PARTY PHOTO 6-867-7

Photograph 10. - Terraces of ancient Lake Lahontan, West Humboldt Range, as seen from the natural dike south of the Humboldt lakes. The steep, thinly vegetated slopes of this portion of the West Humboldt Range, with their extensive acreage of barren, rocky or inaccessible areas, have little value for livestock use. FIELD PARTY PHOTO 6-893-11

bordered on the south and west by a playa. Below these lakes a gravel bar, created by wind action and the resulting water currents in ancient Lake Lahontan, forms a natural dike between the Trinity and West Humboldt Ranges. A natural channel, deepened by dredging, cuts through the dike. Through this channel the infrequent high waters of Toulon and Humboldt Lakes discharge into the large sink area beyond the dike.

Soils developed in flood plain and delta alluvium often have little or no profile development. In contrast, soils developed on older fan deposits commonly have a well-developed profile overlying limepan, and are blanketed by up to one and one-half feet of material consisting dominantly of loess. Lower aggradational slopes frequently contain buried soils, indicating a period of stable surface prior to renewal of aggradation or erosion.

Ground Water

Strata dissected by the Humboldt River include two dominantly lacustrine layers, separated by a layer of alluvium. The lower lacustrine layer is 100 feet thick or more, while the upper layer varies in thickness from 50 to 75 feet. The latter layer is in turn overlain by recent surface deposits. These two fine-grained lacustrine layers are probably poor to very poor aquifers, but the 50 to 200 feet of alluvium separating them is potentially a good aquifer for water development. Beach, bar, and some lake terrace deposits may be good aquifers, depending upon their position with relation to their ground water table or avenues of recharge. Alluvial fan and extensive lake terrace deposits forming intermediate slopes may be important avenues for ground water recharge; they may contain fair aquifers. On extensive intermediate slope fans, the better locations for water well development usually occur from half-way down to near the toes of the fans. Good aquifers may also occur in coarser deposits associated with streams.

Thickness of Tertiary and Quaternary valley fill is variable,with the maximum thickness being unknown. Character of the valley fill underlying deposits exposed by the entrenched Humboldt River is not well known; it probably includes lacustrine, alluvial, and volcanic deposits. A transition occurs between generally unconsolidated Quaternary valley fill and older generally partially consolidated Tertiary valley fill. Tertiary deposits are not good aquifers because of their slow rate of water transmission, generally supplying only sufficient water for low capacity wells, as for livestock water.

Ground water recharge in the sub-basin is from: (1) inflow from the Winnemucca basin; (2) seepage from the Humboldt River, Rye Patch and other reservoirs; (3) seepage through alluvium from precipitation in mountainous areas; and (4) irrigation.

Much of the ground water beneath the Lovelock Valley and Humboldt Lakes and playa has a relatively high dissolved solids content, and is not satisfactory for domestic, livestock, or irrigation use. Several factors contribute to this problem, such as: (1) salt content in the water released from Rye Patch Reservoir; (2) water uses and losses occurring through evaporation and transpiration, which concentrate residual evaporites; and (3) leaching of mineral matter from lacustrine marls and other fine-grained lake sediments. Much of the ground water occurring in fine-grained deposits in the Imlay area may have a moderate to high dissolved solids content.

Water in the Humboldt River which reaches Rye Patch Reservoir is mineralized, averaging between 400 and 700 parts per million of total dissolved salts. As contrasted with the inflow, the water released from Rye Patch has a greater concentration of total dissolved salts, depending upon the volume of carryover storage and amount of inflow during the year. The water quality, however, is such that adequate drainage and good water

management practices are essential in maintaining a favorable salt balance and soil conditions suitable for good plant growth. The return flow from irrigation discharging into the Humboldt lakes is not suitable for irrigation.

The most favorable areas for obtaining good quality ground water appear to be the middle portions of extensive alluvial fans, where aquifers receive ground water recharge from adjacent high mountains. This is evidenced in the few yielding wells in the vicinity of Oreana.

Soils

Soils in the mountainous areas have been developed on sedimentary and volcanic deposits. They vary in depth from shallow to deep, are stony or gravelly medium textured, and are well to excessively drained.

On the upland benches and terraces the soils have developed primarily in alluvium. They are mostly moderately deep to deep, medium to stony or gravelly medium textured, and well-drained. The salt and alkali concentrations vary from none to slight. There are some shallow soils that are underlain by a cemented claypan or cemented gravel.

The soils in the floodplains are mostly lake sediments, or reworked lake sediments which may be mixed with alluvium or windblown deposits. They are mostly deep, medium to fine textured, imperfect to poorly drained, and have salt and alkali concentrations that vary from slight to strong.

Soils in Lovelock Valley have been formed, for the most part, under conditions of poor drainage with a fluctuating high water table. Consequently, the soils have a rather high organic matter content, and exhibit a uniform textural transition from upper valley to lower valley. In the upper valley, the soils are generally medium textured and moderately permeable, grading to fine textured and slowly permeable soils in the lower valley. In the southern portion of the lower valley, which has in more recent times been inundated by Humboldt Lake, there is a bank of medium textured soils which is very high in organic matter. A considerable area in the lower valley, and a number of scattered areas in the upper valley, have not been adequately drained. As a result, a fluctuating high water table persists, together with the accompanying salinity and alkali problems. Soils here are, for the most part, slowly permeable, and located in areas where drain outlets are difficult to design and construct. (See Soils Description and tables 7 and 8, Appendix I.)

A National Cooperative Standard Soil Survey has been completed in the Lovelock Valley. The material from this survey has recently been published and is available for general use.

Precipitation

The climate of the sub-basin is arid, characterized by low precipitation, high summer temperatures, and high evaporation rates. Average annual precipitation in the sub-basin varies from about four inches in Lovelock Valley and six inches at Imlay, to 25 inches on Star Peak (elevation 9,834 feet). During the 70 years of record at Lovelock the annual precipitation has fluctuated between a low of one inch and a high of 12 inches.

In the mountainous areas of the sub-basin the average annual precipitation, as determined from data collected at gaging stations and from the water balance studies, is as follows:

East Range precipitation varies by elevation from eight to 15 inches (elevation 5,000 to over 7,000 feet).

Humboldt Range precipitation varies by elevation from eight to 18 inches (elevation 5,000 to over 8,000 feet). Around Star Peak (elevation 9,834 feet) the precipitation is estimated to be about 25 inches.

West Humboldt Range precipitation varies by elevation from five to nine inches (elevation 5,000 to over 6,000 feet).

Trinity Range and Eugene Mountains precipitation varies by elevation from seven to 12 inches (elevation 5,000 to over 7,000 feet).

Average annual precipitation for recording stations in and adjacent to the sub-basin is as follows:

Station		Elevation	Years of record	Average annual precipitation (inches)	Extrapolated annual precipitation 1/ (inches)
Hot Springs (Brady)		4,070	27	3.4	---
Brown (Toy)		3,930	17	3.9	---
Lovelock FAA AP		3,900	16	4.4	4.0
Lovelock		3,980	70	4.8	---
Rye Patch Dam		4,140	28	7.1	5.5
Imlay		4,200	87	5.7	---
Winnemucca		4,300	92	8.5	---
Dun Glen Peak	2/	6,000	5	9.7	---
Spaulding Canyon	2/	6,000	4	11.4	---
Limerick Summit	2/	6,100	4	11.4	---

1/ Based on long-term record at Lovelock.

2/ Storage gages. (The gage at Dun Glen Peak is considered to be poorly located; therefore the data are questionable.)

Growing Season

Average annual temperature in Lovelock Valley is about 51 degrees. The length of growing season is estimated to be 130 days (32 degrees F) and 160 days (28 degrees F). Data from the U. S. Weather Bureau Records for stations in and around the sub-basin are as follows:

Station	Average annual temperature: Degree F.	Years of record	Average annual frost-free period: 28° F. (days)	32° F. (days)	Years of record
Lovelock	51.5	65	167	139	42
Lovelock FAA AP	51.1	13	152	124	13
Rye Patch Dam	50.5	27	142	107	13
Imlay	50.4	77	152	126	40
Winnemucca	48.7	58	142	123	42

A 24-year record of seasonal evaporation (May through October) at Rye Patch Dam, using a Class A Pan, indicates an average loss of 57 inches. A partial record for the remainder of the year (November through April) at Rye Patch Dam and at Fallon indicates an additional loss of 18 inches, for a total average annual loss of 75 inches. Converting these data to actual conditions, the average annual gross evaporation from Rye Patch Reservoir would be about 55 inches; the net evaporation would be about 50 inches.

General Cover Types

The predominant vegetal cover over most of the sub-basin is a mixture of shadscale (Atriplex confertifolia) and bud sagebrush (Artemisia spinescens), with shadscale being the more common. Together, they make up slightly over 50 percent of the total sub-basin rangeland area. This shadscale-bud sage cover type occupies the alluvial fans, with fingers extending into the upland bench and terrace sites above (see photograph 11). It also covers many of the valley bottoms, with certain large and distinct exceptions. The first and perhaps most important of these exceptions is the bottomland area immediately contiguous to the Humboldt River, above and below Rye Patch Reservoir. This flood plain is covered with black greasewood (Sarcobatus vermiculatus), scattered saltgrass (Distichlis stricta), and other phreatophytes (see photograph 12). Other exceptions are: (1) the alluvial fans east of the Rose Creek gaging station, where big sagebrush (Artemisia tridentata) and spiny hopsage (Grayia spinosa) predominate; (2) the wide, sparsely covered greasewood flats near Rye Patch, Oreana, and on the fringes of the Lovelock Valley cropland, in the saline bottomland site. Yet another exception consists of islands of winterfat (Eurotia lanata) on Dun Glen Flat and in the swales along the Arabia-Poker Brown Camp road. (See map of range sites.)

Extensive areas of greasewood, alone or with a sparse understory of such other phreatophytes as saltgrass, alkali seepweed (Suaeda fruticosa), green molly (Kochia americana), etc., occur on the semi-playa sites east and west of Toulon and Humboldt Lakes, lying south and west of the Lovelock Valley cropland area. Greasewood is a rather minor component of the alkali flat range site surrounding Humboldt Lake and its playa, as well as the previously mentioned wet saline bottomland site fringing the Lovelock hay meadows and cropland.

The upland bench and terrace sites throughout the sub-basin serve as transition zones between the plant species common to the valley bottomlands and alluvial fans, and the species found on the mountain slopes and uplands. There is considerable overlapping and intermixing of range types on these upland benches and terraces. Shrub species prevalent here in various admixtures and densities are shadscale, bud sagebrush, big sagebrush,

Photograph 11. - Shadscale-bud sage range site in the low forage production class west of Rye Patch Reservoir, looking easterly toward Star Peak in the Humboldt Range. This site comprises slightly more than 50 percent of the total rangeland area in the Lovelock Sub-Basin. FIELD PARTY PHOTO 6-862-5

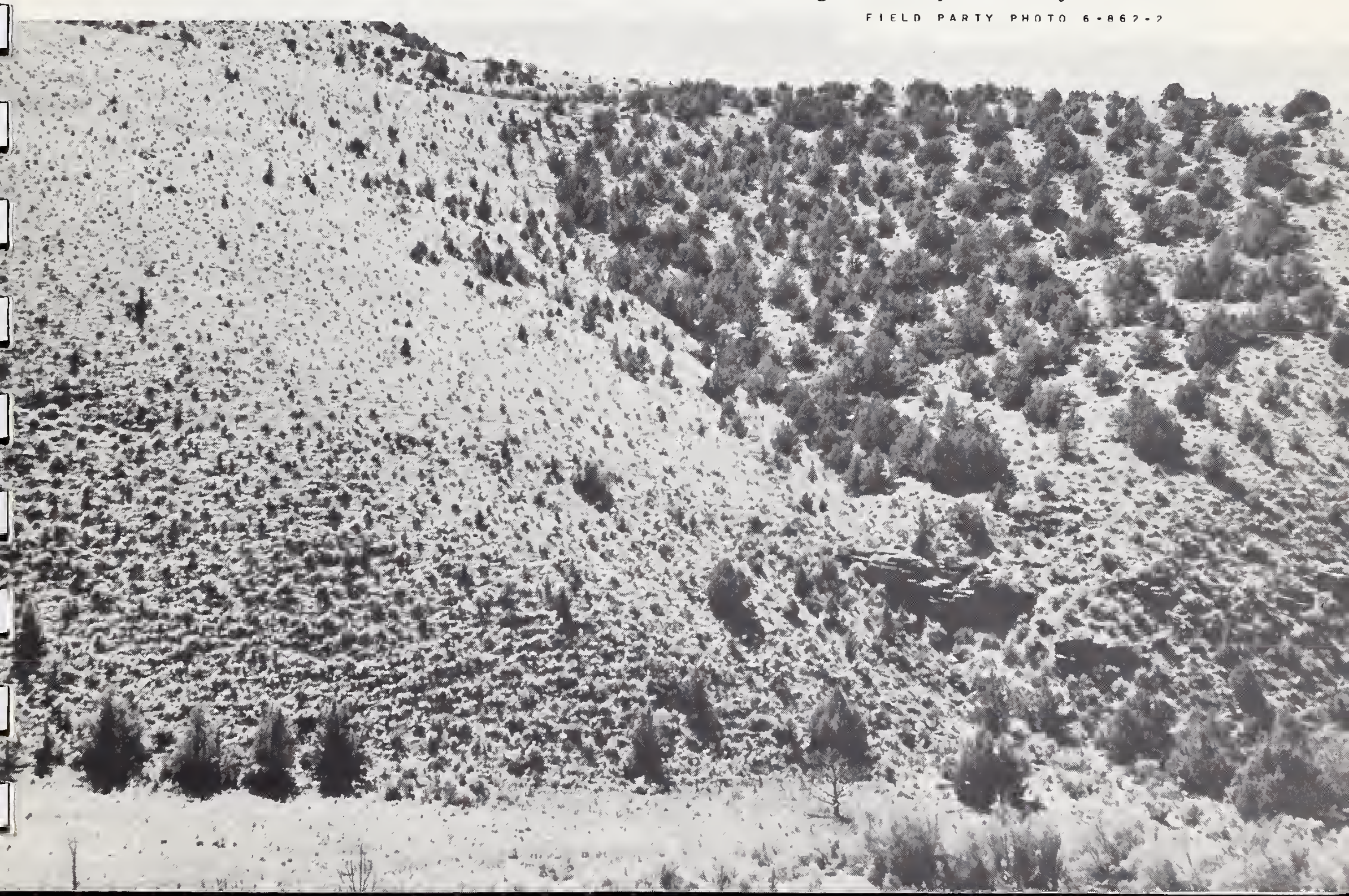
Photograph 12. - Saline bottomland range site on the Humboldt River floodplain, Imlay vicinity, looking west toward the Eugene Mountains. Black greasewood forms the aspect cover here, with a sparse understory of saltgrass and other phreatophytes. FIELD PARTY PHOTO 6-660-12

Photograph 13. - Big sagebrush-grass range site on the upland benches and terraces, Dun Glen Flat, looking south toward Star Peak in the Humboldt Range. The sagebrush overstory here is admixed with spiny hopsage, with a thin understory of cheatgrass, Sandberg bluegrass, and bottlebrush squirreltail.

FIELD PARTY PHOTO 6-851-7

Photograph 14. - Utah juniper invading big sagebrush-grass range which has been heavily overused. Note pronounced terracing from livestock use on the slopes above the stream bottom. Willow Creek, Humboldt Range, east of Mill City.

FIELD PARTY PHOTO 6-862-2



Photograph 15. - Relict area of climax vegetal cover on the upper slopes of Dun Glen Peak, East Range. Idaho fescue is the principal grass present, mixed with Sandberg bluegrass and lupine. In this particular location rockspirea forms a scattered overstory. FIELD PARTY PHOTO 6-851-4

littleleaf horsebrush (Tetradymia glabrata), black sagebrush (Artemisia nova), Bailey greasewood (Sarcobatus baileyi), spiny hopsage, Mormon tea (Ephedra spp.), green molly, desert snowberry (Symphoricarpos vaccinoides), buckwheat (Eriogonum spp.), rabbitbrush (Chrysothamnus spp.), and bush pepperweed (Lepidium fremontii).

Grasses present as a sparse understory to the browse species on the upland bench and terrace sites are Indian ricegrass (Oryzopsis hymenoides), bottlebrush squirreltail (Sitanion hystrix), desert needlegrass (Stipa speciosa), and Sandberg bluegrass (Poa secunda).

In the Humboldt, East, and Trinity Ranges black sagebrush, big sagebrush, or low sagebrush (Artemisia arbuscula) predominates in the vegetal cover on the mountain slopes, from the upland benches and terraces to the ridges and mountain tops (see photograph 13). Black sagebrush is usually present at the lower elevations, while low sagebrush occurs on the mountain tops and ridges, and occasionally extends short distances down the slopes to the juniper and big sagebrush stands. Big sagebrush is the dominant species found on the intermediate mountain slopes range site, intermixed with scattered individual trees or clumps of Utah juniper (Juniperus osteosperma). Big sagebrush and juniper occur in various admixtures with other vegetal species. In some areas, heavy use of the better forage species has allowed Utah juniper to extend itself beyond its natural habitat, and invade what were once chiefly grassland-shrub range sites (see photograph 14).

On the upper slopes and basins of the East and Humboldt Ranges, Idaho fescue (Festuca idahoensis), Nevada bluegrass (Poa nevadensis), Cusick bluegrass (Poa cusickii), oniongrass (Melica spp.), and Sandberg bluegrass are the chief grasses (see photograph 15). They are associated with juniper, serviceberry (Amelanchier spp.), and Douglas rabbitbrush (Chrysothamnus viscidiflorus). On the West Humboldt Range the chief vegetal species present are shadscale and bud sagebrush.

Photograph 16. - Humboldt River at Callahan Bridge, looking upstream toward the East Range. The streambanks here are fringed with willow, smallflower tamarisk (salt cedar), and scattered individual trees or small clumps of cottonwood.

FIELD PARTY PHOTO 6-863-4

In the Eugene and Trinity Mountains, as well as on the lower slopes of the East and Humboldt Ranges, the principal grass species are Thurber needlegrass (Stipa thurberiana), Sandberg bluegrass, thickspike wheatgrass (Agropyron dasystachyum), and cheatgrass (Bromus tectorum), associated with such shrubs as big sagebrush, tall rabbitbrush (Chrysothamnus speciosus), littleleaf horsebrush, desert peach (Prunus andersonii), and currants (Ribes spp). Forbs generally associated with these grass and browse species are phlox (Phlox spp.), locoweed (Astragalus spp.), lupine (Lupinus spp.), buckwheat, and annual mustards.

Bluebunch wheatgrass (Agropyron spicatum) and bitterbrush (Purshia tridentata) were not found anywhere in this sub-basin. It is believed that soils and growing conditions in the sub-basin are generally too primitive or unfavorable for these climax species.

A few small mountain maple trees (Acer glabrum), rather uncommon in central Nevada, are present along the drainages of Star Creek and Prince Royal Canyon.

Many phreatophytic species are present on the bottomlands of the Humboldt River, between Rose Creek Gaging Station and the Humboldt lakes. They are rubber rabbitbrush (Chrysothamnus nauseosus); black greasewood; willow (Salix spp.); cottonwood (Populus spp.); smallflower tamarisk (Tamarix parviflora), one of the salt cedars; Great Basin wildrye (Elymus cinereus); alkali sacaton (Sporobolus airoides); saltgrass; creeping wildrye (Elymus triticoides); seepweed; bassia (Bassia hyssopifolia); pickleweed (Allenrolfea occidentalis); and white sweetclover (Melilotus alba). (See photograph 16.)

Smallflower tamarisk occurs in more or less thick-growing clumps and stands, averaging about 15 feet in height, on the alkali flat site between Toulon and Humboldt Lakes, and east of Humboldt Lake. Similar tamarisk fringes are found on the alkali flat site fringing the playa between Humboldt Lake and the Humboldt dike, as well as along the drains across this playa. Scattered tamarisk borders the deepened natural channel through the Humboldt dike and along the Humboldt Slough channel emptying into the Humboldt sink, south of the dike in the White Plains area.

Tamarisk also appears as a more or less prominent fringe along the upper margins of Rye Patch Reservoir, and as scattered individual plants or clumps growing along the main stem of the Humboldt, both above and below the reservoir.

The U.S. Bureau of Reclamation and the University of Nevada, in a continuing effort to develop more efficacious control methods for tamarisk, have established a series of experimental plots to test various procedures now in use. The Bureau's plots are located on the east side of Rye Patch Reservoir, and University's on Rye Patch's west side and along the east side of Humboldt Lake.

As previously noted, the main stands of phreatophytic black greasewood, with shadscale, bud sagebrush, quailbrush (Atriplex lentiformis,) rubber rabbitbrush, fourwing saltbush (Atriplex canescens), cottonthorn horsebrush (Tetradymia spinosa), and littleleaf horsebrush, are located on the benchlands near Oreana and Rye Patch. They also are found fringing the cropland in Lovelock Valley and around Humboldt and Toulon Lakes, on the alluvial fans around Imlay and Mill City, and on the bottomlands east of Mill City. A few widely dispersed plants of saltgrass, Great Basin wildrye, and squirreltail occur as an understory to the greasewood stands.

Dunes and light-textured soils generally form a fringe to the Humboldt River bottomlands from the backwaters of Rye Patch Reservoir to the stream gage at Rose Creek. Vegetal species found in this area are Indian ricegrass, needle-and-thread (Stipa comata), western wheatgrass (Agropyron smithii), littleleaf horsebrush, cottonthorn horsebrush, spiny hopsage, fourwing saltbush, hairy horsebrush (Tetradymia comosa), scurfpea (Psoralea spp.), mallow (Malva spp.), dalea (Dalea fremontii), and evening primrose (Oenthera spp.).

Considerable barren area, in the form of playas, stretches across the southern tip of Humboldt and Toulon Lakes. Much of the reservoir storage area of the Pitt-Taylor dams is also classified as playa. The steep, sterile upper slopes of the West Humboldt and Trinity Ranges, bordering the southern extremity of the sub-basin to the east and west, include extensive areas of barren, rocky, or inaccessible range (see photograph 10).

Water Yield

Irrigation water supply is derived primarily from the Humboldt River. Runoff in the river is collected in Rye Patch Reservoir and distributed to irrigated lands in Lovelock Valley throughout the irrigation season.

In general, the quality of water flowing into Rye Patch Reservoir is of low to medium salinity, and is a low sodium hazard water. In contrast, water released from the reservoir during the irrigation season is of medium to high salinity, and of low to medium sodium hazard. The quality of water changes from year to year, depending upon the amount of carryover storage in the reservoir and the quantity of inflow to the reservoir during the year.

Rye Patch Dam was built by the Bureau of Reclamation in 1935-1936 (see cover photograph). At present the reservoir has a maximum capacity of 192,000 acre-feet. Since the completion of the Rye Patch Dam, there have been five years when the inflow, plus storage, was large enough to force releases greater than those required for all use. Also there have been six years of low flow, plus storage, when the releases from the reservoir were less than 75,000 acre-feet.

The Pitt-Taylor Dams were built from 1910 to 1913, with a reservoir storage capacity of 48,000 acre-feet. At present the reservoirs behind these dams are used to store water during high flow years when it is apparent that Rye Patch Reservoir will not hold the total flow. These reservoirs have a present maximum capacity of 25,000 acre-feet. Water has been diverted into these reservoirs nine times since 1937. It is reported that because of evaporation loss only approximately one-half of the diverted water becomes available for release to Rye Patch Reservoir.

A study of the water supply for the Lovelock Sub-Basin necessarily has been different from those of the other sub-basins in the Humboldt Basin, because of the presence of Rye Patch Reservoir. In this study it was found there is poor correlation between individual monthly and yearly streamflow and storage records. Time would not permit research into the volumes of daily records, to find answers to some of the questions. For this reason no attempt has been made to present a detailed analysis of the reservoir operations. The water balance study was confined to the areas above and below the Rye Patch Reservoir (see Water Balance Study, Appendix I).

Figure 1 is a flow diagram computed from the 1949-1963 stream flow records, showing the average water yields, uses, and losses between Rose Creek gage and Imlay gage. In this analysis the inflow contributed from Gumboot Lake in Paradise Valley (1953 and 1958) was subtracted from the gage records at Rose Creek and Imlay before the average was computed. The results of the study indicate about 3,400 acre-feet of water not accounted for between these stream gages. This difference might be attributed to any one or a combination of several uses or losses, such as underflow at the Imlay gage (depth to the aquifer unknown), additional consumptive use, or accuracy in stream gage readings.

Figure 2 is a flow diagram of the area below the Rye Patch stream gage. This diagram represents average conditions for the agricultural lands for the period 1951 to 1963. This short period of record was used because it represents present water use conditions. Although the acreage of land being developed for irrigation in Lovelock Valley has been increasing since 1936, the total acreage under irrigation has leveled off since the early 1950's. Also, the number of acres planted to alfalfa seems to have stabilized during this period. The flows from Gumboot Lake, 1953 and 1958, were not subtracted from the reservoir release records because it would be difficult to separate these flows from the effects of carryover storage in Rye Patch Reservoir.

The high water year of 1952 is part of the period analyzed, and may distort average values for the 13 years, 1951-1963. In 1952 297,000 acre-feet were released to the Humboldt lakes; of this total release, about 200,000 acre-feet flowed from these lakes through the outlet channel in the Humboldt dike.

Figures 3 and 4 are flow diagrams for the sub-basin, above and below Rye Patch Reservoir, representing an 80 percent occurrence. A longer period of record was used for this evaluation, because the use of probability analysis is less affected by extreme flows, as would be the case when computing averages. The difference between the 55,000 acre-feet inflow at Imlay and the 75,000 acre-feet released at the Rye Patch gage can be attributed to the influence of storage in Rye Patch Reservoir. This evaluation illustrates

Figures 1 and 2. -- Flow diagrams of gross water yeilds and depletions in acre-feet for the Lovelock Sub-Basin (average flow)

Figure 1. -- Above Rye Patch Reservoir

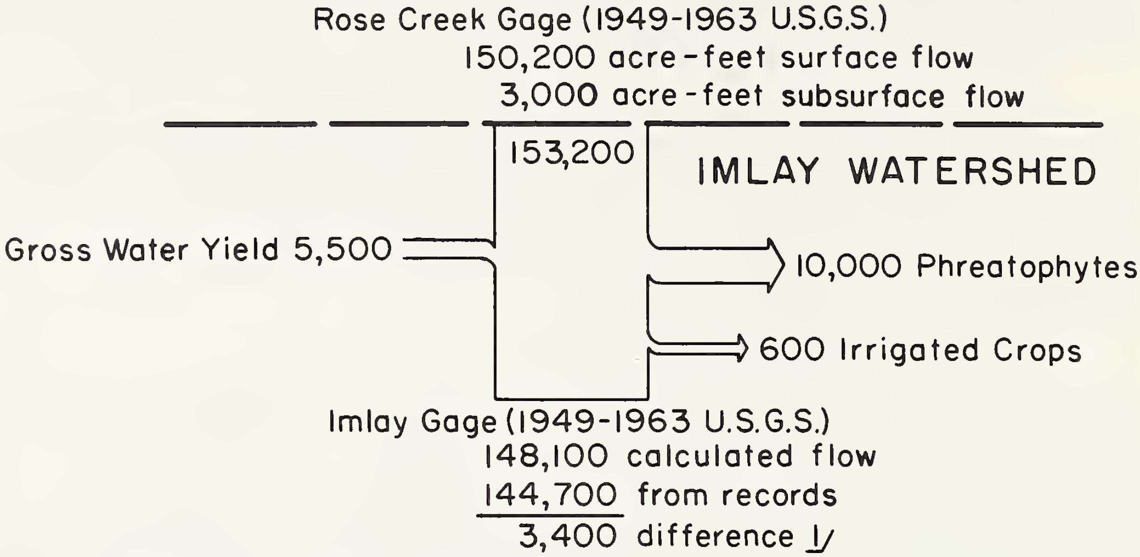
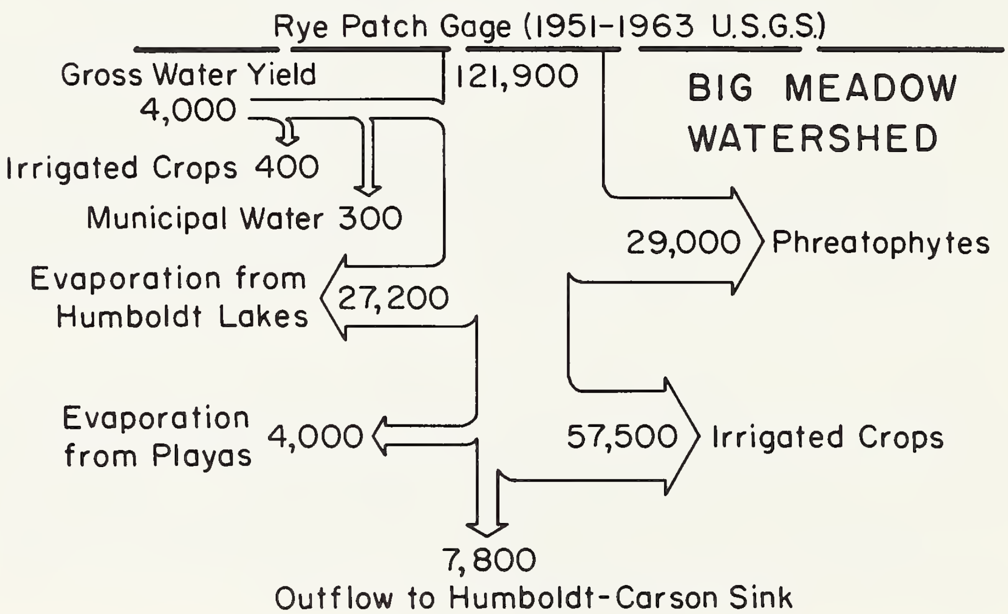


Figure 2. -- Below Rye Patch Reservoir



1/ Difference may be attributed to underflow at the Imlay gage (depth to aquifer unknown), additional consumptive use, accuracy in stream gage readings, an over-estimation of gross yield, or a combination of these uses and losses.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

Figures 3 and 4. -- Flow diagrams of gross water yields and depletions in acre-feet for watersheds in the Lovelock Sub-Basin (80% frequency)

Figure 3. -- Above Rye Patch Reservoir

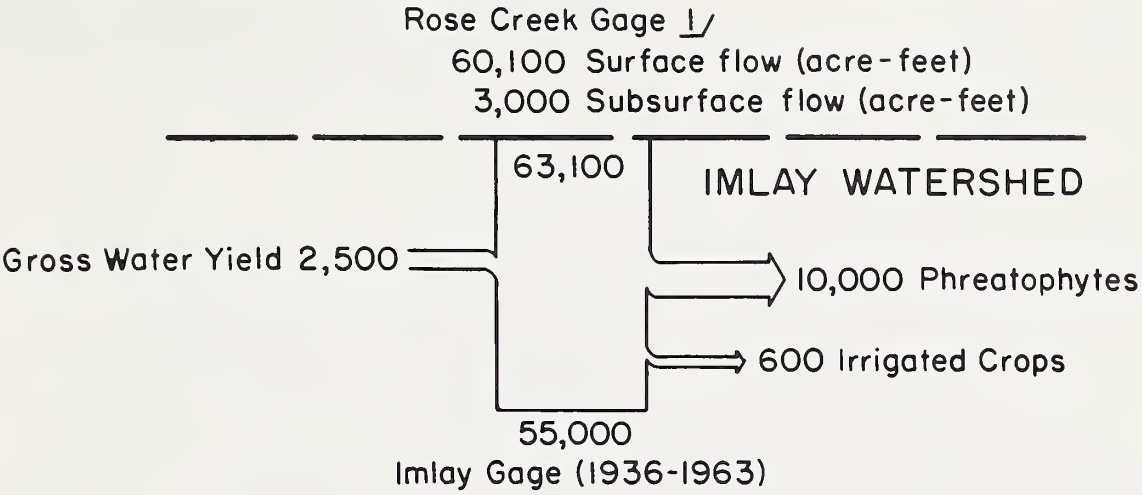
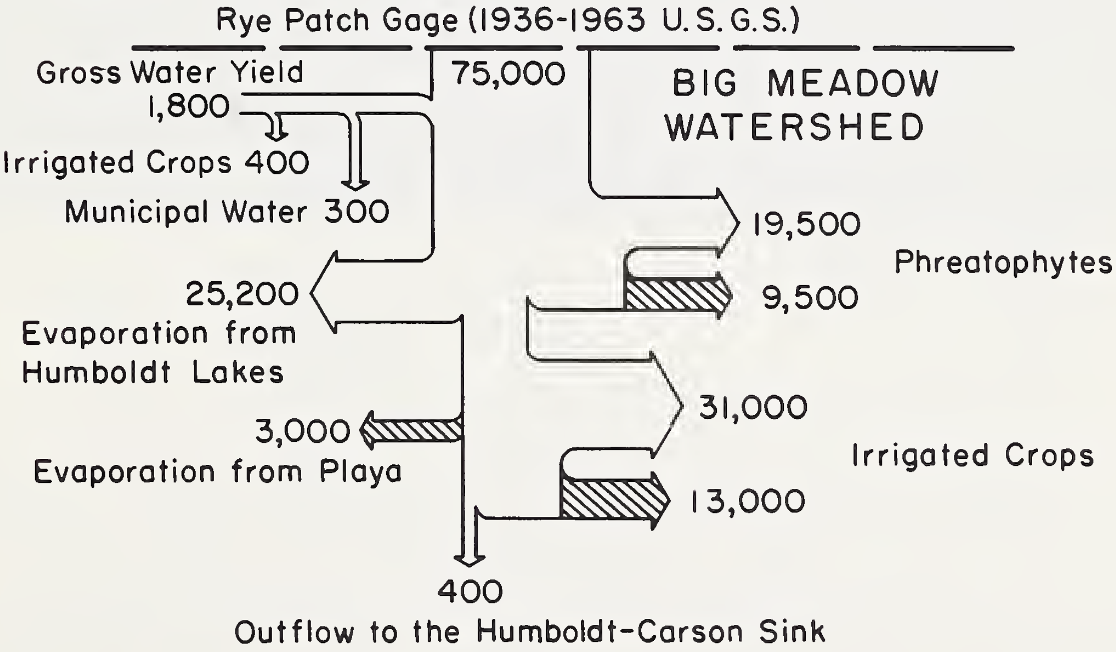


Figure 4. -- Below Rye Patch Reservoir



1/ Fifteen-year record (1949-1963 U.S.G.S.) extended to 49 years (1895-1963) compared to the Comus gage.

▨ The estimated quantity of water used from ground water storage.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

what some authorities believe: namely, that there would be less chance of crop loss if the farming enterprise were designed around an 80 percent chance of having a full water supply.

The water used from ground water storage is in excess of yield and reservoir releases. The ground water is recharged during years when greater quantities of water are available.

LAND AND WATER USE

Land Status

There are approximately 130 land owners in the Lovelock Sub-Basin, not including lands within the boundaries of municipalities, small communities, or other small tract sub-divisions. This ownership record has been compiled from data of the Bureau of Land Management at Winnemucca, the Soil Conservation Service Work Units at Winnemucca and Lovelock, and the Pershing County Water Conservation District at Lovelock. Sections of Federal and private (formerly railroad) lands are intermingled in a checkerboard pattern throughout the sub-basin. Included in the private land are an estimated 273,200 acres owned by the Southern Pacific Land Company (27 percent of the total sub-basin acreage), and 500 acres by the municipality of Lovelock. Twenty acres are held by the Lovelock Indian Colony. Approximately 11,000 acres are included within the maximum storage area of the Rye Patch Reservoir of the Humboldt Project.

The approximate land status breakdown is as follows:

Land Status	Square miles	Acres	Percent of total
Public Domain	825.0	528,000	50.4
Bureau of Reclamation (Humboldt Project)	63.7	40,800	3.9
County and State	4.1	2,600	.2
Private	744.7	476,600	45.5
Total	1,637.5	1,048,000	100.0

Land Use

The public domain is used primarily for grazing of domestic livestock. Grazing licenses are issued on the basis of spring-fall, winter, and summer range use, depending upon location and type of range. Portions of these lands also serve as habitat for big game and other wildlife. The long-range land program of the Bureau of Land Management includes encouragement of land exchanges, in order to establish a more desirable land ownership pattern, particularly on high watershed lands. The bulk of the current grazing on public domain range is in community allotments; however, the division of range into individual allotments is progressing. Recreation is becoming an important phase of the Bureau of Land Management program. The Bureau's proposed recreation development program is briefly discussed in the recreation and wildlife section.

Private lands are used for the production of irrigated crops and range forage (see photograph 17). In many instances exchange of use agreements are developed with owners of private intermingled range lands, and these areas are then administered with public lands by the Bureau of Land Management. Most of the irrigated land is used to produce feed for livestock.

Photograph 17. - Baled alfalfa hay ready for hauling to the stackyard, Lucky Land & Livestock Company Ranch, Lovelock Valley. FIELD PARTY PHOTO 6-868-12

Except for four ranches, which have a relatively small amount of cropland, the land used to produce irrigated crops is all in Lovelock Valley, below the Rye Patch Reservoir. The acreage of irrigated cropland within the Pershing County Water Conservation District and types of crops grown for the years 1939 through 1964 are shown in table 1.

Water Rights

Water rights were established by the George A. Bartlett Decree of 1931 and subsequent permits from the State Engineer's office. In general, the decreed rights provide for a flow of 0.81 c.f.s. per 100 acres of decreed land, or at proportional rates for specific periods of time. Under this decree, and permits from the State Engineer, 33,300 acres of land within the Pershing County Water Conservation District were given water rights totaling 87,896 acre-feet. Subsequently, 867 acre-feet of water were transferred from 1,664 acres of land purchased for the Rye Patch Reservoir site, and 48,773 acre-feet of water from 32,182 acres were purchased in the Battle Mountain area. Except for the small amount of water which is used on an acreage of land in Battle Mountain basin, where physical conditions rendered transfer difficult, all this water has been transferred to the Humboldt Project.

After the completion of the Rye Patch Dam and the transferral of the purchased water rights to the Humboldt Project, the water rights assigned as meadow pasture and diversified pasture within the project area were converted, by proportion, to harvest rights. The following tabulation shows the present acreage of land with water rights, and the decreed and permitted acre-feet of water in the sub-basin.

	Acres of land	Acre-feet of water
Pershing County Water Conservation District	37,086	137,536
Other Land in Pershing County	3,798	7,297
Total	40,884	144,833

Included in the Other Land in Pershing County category are about 2,500 acres in the Imlay-Mill City area, which receive water from Humboldt River, 200 acres near Oreana which are irrigated from underground water, and 1,100 acres of nonproject land in Lovelock Valley which receive water from the river through the Rye Patch Reservoir.

The State Engineer recognizes that the data in the above tabulation do not agree with the summarization of acres of land and acre-feet of water given in Findings of Fact 41 and 42, Bartlett Decree, on pages 27 and 28 of the Compiled Edition, Humboldt River Adjudication. Certain duplications in the decree increase the total of decreed and permitted water, and some water covered by permits issued by the State Engineer is not included in the data given in the decree. Also, the transfer of water from the Battle Mountain district previously mentioned has resulted in a reduction in the acreage of irrigated land having water rights, primarily because of the conversion of meadow and pasture rights to harvest rights. In addition, some irrigated land shown as located in the Winnemucca district in Humboldt County in the Order of Determination of the State Engineer was removed from this district and credited to Pershing County when this county was created in March 1919.

Water Use

Water in the sub-basin is used as shown in figures 1 through 4 and is summarized as follows:

Above Rye Patch Reservoir

	Average		80 percent frequency	
	Acres	Acre-feet	Acres	Acre-feet
Irrigated crops	400	600	400	600
Phreatophytes	28,000	10,000	28,000	10,000
Discharge to reservoir		144,700		55,000
Total		155,300		65,600

Below Rye Patch Reservoir

	Average		80 percent frequency	
	Acres	Acre-feet	Acres	Acre-feet
Irrigated crops	25,800	57,900	23,200	44,400
Phreatophytes	58,000	29,000	58,000	29,000
Surface water evaporation		27,200		25,200
Evaporation from playa		4,000		3,000
Municipal water		300		300
Outflow		7,500		400
Total		125,900		102,300

For the purpose of this report, 2,100 acres of the 2,500 with water rights in the Imlay-Mill City area are included with phreatophytes, because the area is not currently in production. This is recognized as a temporary situation, and when the area is returned to production will result in an addition of an estimated 1,000 acre-feet of use. Most of the cropland is in Lovelock Valley, and is irrigated with water from the Rye Patch Reservoir (see photograph 18). About two-thirds of the phreatophytic plants also grow in the lower valley where the water table is relatively close to the ground surface. Stock water is another important water use, as well as on-site requirements for trees, shrubs, and grass on the watershed.

Alfalfa grown in Lovelock Valley acts as a phreatophyte. Data released by the University of Nevada Experiment Station indicate that alfalfa grown on land with a five or six-foot water table will obtain about 50 percent of its water requirement from ground water. Farmers in the valley report they have received yields of one and one-half tons of hay from old stands of alfalfa without irrigation.

Photograph 18. - Border irrigation, lower Lovelock Valley, looking west toward the Trinity Range. (The borders are visible as dark lines on each side of the photograph.) Waters of the Humboldt River, impounded in Rye Patch Reservoir and apportioned proportionately among the Pershing County Water Conservation District ranchers, are the veritable lifeblood of Lovelock Valley. SCS PHOTO 6-870-8

Besides alfalfa, other ground water use is by phreatophytic plants, municipal water for Lovelock, a few low-capacity stockwater and farmstead wells, and water pumped for 720 acres of cropland.

Gross consumptive use requirements for crops grown in Lovelock Valley, as computed by the Blaney-Criddle Improved Coefficient Method, under proper management and producing maximum yields, are as follows:

Alfalfa	31 inches 1/
Spring grain	18 inches
Winter wheat	23 inches
Corn silage	17 inches
Sugar beets	29 inches
Grass pasture	28 inches

1/ Based on crop use without a water table. This rate of use would increase in the presence of a water table.

In Lovelock Valley it is necessary to apply water in excess of that required for plant growth, when available, to leach out salt accumulations in the soils (see photograph 19). It should be noted, however, that adequate drainage is a requirement for effective leaching.

Irrigation Methods

Several methods of irrigation are used in the sub-basin, depending on the type of crops grown, soils, availability of water, and experience of the owner. The methods used consist of borders, furrows, and flooding.

In Lovelock Valley most of the cropland is irrigated by the border method (see photograph 20). The borders vary in width from 40 to 300 feet, and heads of water from 2 to 35 c.f.s. per border are used. The crops grown under this system are mostly alfalfa, corn silage, small grain, and improved pasture. Furrow irrigation is used on cropland planted to row crops, such as beets and potatoes.

An estimated one-fourth of the cropland in the valley has been leveled to grade. The remaining land has been smoothed, and is being leveled at the rate of 1,000 to 1,500 acres each year. On-the-farm irrigation efficiencies are improving in the valley as more farmers are coming to realize the benefits of better water management practices. Recent irrigation evaluations indicate efficiencies varying from 25 to 70 percent.

Cropland outside the Lovelock Valley is irrigated either by direct diversion of water from the Humboldt River or from pumped wells. Along the Humboldt River, meadow hay and pasture lands are flood-irrigated. Above the river flood plain, pumped water is used to irrigate alfalfa in borders, and sugar beets (1964) in furrows.

Improved irrigation developments in the sub-basin consist of diversion dams, canals and field ditches, land leveling, pipelines, water wells, drainage, and a small amount of concrete ditch lining. In addition, a large number of water control structures have been installed in the field ditches (see photographs 18, 19, and 21).

Photograph 19. - Water application using the border irrigation method. Applying water in excess of plant growth requirements, as seen here, is periodically necessary in Lovelock Valley, in order to leach out salt accumulation in the soils. Lower Lovelock Valley, looking westward toward the Trinity Range.
SCS PHOTO 6-870-3

Photograph 20. - Aerial view of a portion of upper Lovelock Valley, showing typical irrigated cropland layout and water distribution systems. (Looking toward the West Humboldt Range.)
SCS PHOTO 6-825-5

Photograph 21. - Irrigation canal with drop structure, lower Lovelock Valley about two miles south of Lovelock, looking eastward to the West Humboldt Range.
FIELD PARTY PHOTO 6-868-8

THE AGRICULTURAL INDUSTRY

Cropland in the Lovelock Sub-Basin lies principally in the Lovelock Valley. The Bureau of Reclamation developed the Humboldt Project (1935-1936) to stabilize the water resources for the valley. According to the U.S. Irrigation Census Map of irrigated land for Nevada in 1959, a total of 33,000 acres of land was irrigated in Pershing County. Of this total 31,000 acres were located within the sub-basin, 2,000 of which were irrigated from ground water, and 29,000 from surface flow. The census showed no irrigated land in the portion of the sub-basin in Churchill County.

Unless otherwise noted, data in this section were obtained from University of Nevada bulletins, U.S. Census of Agriculture, and individual ranch and farm observations.

Farm and Ranch Characteristics

Number of farms in Pershing County changed little between 1939 and 1959, according to the U.S. Census of Agriculture. However, during this same period average

size of farm increased from 815 acres to 7,678 acres; some of the increase in average farm size was the result of changes in census definitions. These trends may be observed in the following data:

	Unit	1939	1944	1949	1954	1959
Number of farms	Number	108	127	126	117	115
Average farm size	Acres		1,114	3,507	5,417	7,678

Number of farms in the Humboldt Project was 105 in 1950, and 100 in 1963. Average size of these farms for the above years was 360 and 396 acres respectively, in contrast with the larger average farm size for Pershing County as a whole.

More diversified farms were reported in Pershing County than for any other county in the Humboldt River Basin. Of 115 farms in the county in 1959, 94 were commercial operations, which were classified as follows: 73 range livestock, seven field crops, and 14 general. Twenty-one farms were reported as miscellaneous and unclassified. The following tabulation shows the trend in farm type for Pershing County from 1949 to 1959, and the sub-basin estimate for 1963:

Item	Pershing County 1/ 1949	1954	1959	Lovelock 2/ Sub-Basin estimate 1963
	Number			
Field crops	24	3	7	27
Poultry	5	5	--	--
Range livestock	31	42	73	58
General	54	37	14	14
Miscellaneous and unclassified	12	30	21	21
Total	126	117	115	120

1/ U.S. Census of Agriculture. 2/ Humboldt River Basin Field Party

Fully owner-operated farms comprised 56 percent of all those in the county. Thirty percent were operated by part owners, eight percent by managers, and seven percent by tenants. The trend in farm tenure in Pershing County from 1949 to 1959 was as follows:

	1949	1954	1959
	Number		
Full owners	82	63	64
Part owners	21	37	34
Managers	5	5	9
Tenants	18	12	8
Total	126	117	115

Source: U.S. Census of Agriculture.

In 1964 there were 120 farms and ranches in the sub-basin, all but four of which were headquartered there. Some ranches were completely within the sub-basin, while others included holdings in other areas.

About 35 percent of the farmers (40) in Pershing County worked off the farm in 1959. Of these, 78 percent worked 100 or more days off the farm; all farmers in this category received incomes for their off-farm work greater than the value of their farm products sold. The trend in off-farm employment from 1949 to 1959 was as follows:

Item	1949	1954	1959
	Number		
Farmers working off-farm	39	44	40
Farmers working off-farm 100 or more days	27	27	31
Farmers with other income greater than farm products sold	10	17	40

Source: U.S. Census of Agriculture.

In 1954, 15 farms in Pershing County had no tractors or horses for work power, 11 had two or more horses, 48 had tractors and horses, and 33 farms had tractors and no horses. The trend has been toward mechanized power, with farms having tractors increasing about 36 percent between 1949 and 1954.

Value of Agricultural Products and Inputs

Pershing County farmers received 77 percent of their gross farm receipts from the sale of livestock and livestock products in 1959. Only a small income was derived from the production and sale of dairy products, and poultry and poultry products. All crops sold amounted to $1,137,618, or 23 percent of the total gross receipts. Gross farm receipts in Pershing County almost doubled between 1954 and 1958, as shown in the following tabulation:

Item	1954	1959
	Dollars	Dollars
All livestock and livestock products sold	1,450,991	3,890,068
Poultry and poultry products sold	6,917	3,010
Dairy products sold	5,515	22,350
Livestock and livestock products other than dairy and poultry	1,438,559	3,864,708
All crops sold	1,252,902	1,137,618
Field crops	1,252,867	1,137,613
Vegetables	30	---------
Fruit	5	5
Value of all farm products sold	2,703,893	5,027,686

Source: U.S. Census of Agriculture.

A large portion of the income from livestock and livestock products in the county was derived from the sale of cattle imported into the sub-basin and finished there.

Farm expenditures, both capital and operating, have been increasing. The major increase is attributed to the purchase of feed for livestock and poultry. Specified farm expenditures in Pershing County for 1954 and 1959 were as follows:

Item	1954	1959
	Dollars	Dollars
Feed for livestock and poultry	99,001	775,564
Purchase of livestock and poultry	------	550,285
Machine hire	147,692	174,904
Hired labor	372,078	470,346
Gasoline and other petroleum	156,910	171,387
Seed, plants and trees	------	19,565

Source: U.S. Census of Agriculture.

Crop Production

Total cropland harvested in Pershing County has been increasing. In 1939 there were 17,087 acres harvested, while in 1959 harvested cropland amounted to 29,226 acres. Two-thirds of this cropland were in hay and one-third in grain in 1959. This county produces more grain than any other county in the Humboldt River Basin. The trend in cropland harvested in Pershing County between 1939 and 1959 was as follows:

Item	1939	1944	1949	1954	1959
	Acres				
Grain	3,010	6,095	12,215	7,796	9,036
Hay	12,302	14,508	15,161	15,157	20,048
Other	1,775	488	430	804	362
Total cropland harvested	17,087	21,091	27,806	23,757	29,446

Source: U.S. Census of Agriculture.

Cropping records available for the Humboldt Project in Lovelock Valley from 1939 to 1963 indicate that the project area accounted for about 98 percent of the cropland in the sub-basin. In 1963, cropland within the sub-basin, but outside the Humboldt Project, amounted to approximately 200 acres of native meadow hayland between Imlay and Mill City, and a small acreage of alfalfa and sugar beets at Rye Patch and Oreana. However, little or no hay was harvested from the meadow hayland in these portions of the sub-basin in 1963 or 1964.

From 1939 to 1963, barley, wheat and alfalfa production accounted for about 90 percent of the crop acreage harvested annually on the Humboldt Project. (See table 1.) During the 1940's barley played a major role in the cropping pattern of the project area. However, from 1950 to 1959, it declined in importance, averaging only about 10 percent of the total acreage for the three major crops. In 1961 no barley was reported harvested in the area. Wheat acreage constituted a fifth of all crops during the 1950-1959 period.

Table 1. -- Acreage and yields of specified crops for cropland harvested, Humboldt Project, 1939-1963

Year	Total cropland harvested		Barley			Wheat			Alfalfa			Misc. crops and irrigated pasture	
	Acres	Percent	Acres	Yield Bu./Ac.	Percent of total	Acres	Yield Bu./Ac.	Percent of total	Acres	Yield Tons/Ac.	Percent of total	Acres	% total
1939	11,874	100	607	46	5.1	2,145	27	18.1	6,581	3.5	55.4	2,541	21.4
1940	11,920	100	897	41	7.5	2,460	30	20.6	6,474	4.0	54.4	2,089	17.5
1941	11,728	100	1,741	52	14.8	1,565	30	13.3	6,599	3.5	56.4	1,823	15.5
1942	12,577	100	2,968	52	23.6	1,499	30	11.9	7,270	3.5	57.8	840	6.7
1943	12,139	100	2,074	32	17.1	1,287	30	10.6	8,128	3.5	67.0	650	5.3
1944	16,421	100	3,196	52	19.5	2,006	30	12.2	11,078	3.2	67.5	141	.8
1945	17,928	100	2,126	45	11.8	3,298	28	18.4	10,623	2.9	59.3	1,881	10.5
1946	21,537	100	2,386	48	11.1	6,477	30	30.1	10,416	3.4	48.3	2,258	10.5
1947	24,506	100	5,070	35	20.7	5,840	28	23.8	10,398	3.1	42.5	3,198	13.0
1948	25,085	100	9,890	28	39.4	5,475	25	21.8	8,154	3.0	32.6	1,566	6.2
1949	25,028	100	6,670	35	26.6	4,817	28	19.2	11,954	3.7	47.9	1,587	6.3
1950	25,414	100	4,600	33	18.1	3,300	33	13.0	13,000	3.4	51.1	4,514	17.8
1951	25,438	100	2,441	33	9.6	5,660	33	22.2	14,817	3.5	58.3	2,520	9.9
1952	25,365	100	2,036	30	8.0	4,556	30	18.0	14,515	4.0	57.2	4,258	16.8
1953	29,363	100	2,134	40	7.3	5,499	30	18.7	16,289	4.0	55.5	5,441	18.5
1954	29,960	100	3,910	45	13.0	4,411	35	14.7	15,601	4.0	52.1	6,038	20.2
1955	20,275	100	34	50	.2	-----	--	----	16,293	2.5	80.4	3,948	19.4
1956	28,700	100	1,747	46	6.1	6,203	40	21.6	15,278	3.8	53.2	5,472	19.1
1957	26,715	100	1,356	50	5.1	6,161	39	23.1	14,496	3.5	54.2	4,702	17.6
1958	29,148	100	1,980	46	6.8	7,796	40	26.7	15,478	3.2	53.1	3,894	13.4
1959	28,542	100	3,226	43	11.3	5,735	40	20.1	16,670	2.8	58.4	2,911	10.2
1960	20,973	100	257	27	1.2	2,121	33	10.1	16,575	2.8	79.0	2,020	9.6
1961	16,157	100	-----	--	----	72	21	.4	15,553	2.8	96.3	532	3.3
1962	26,490	100	2,402	57	9.1	5,735	47	21.6	15,720	3.5	59.4	2,633	9.9
1963	26,265	100	1,242	51	4.7	6,100	49	23.2	15,310	3.4	58.3	3,613	13.8
1964	28,780	100	2,372	61	8.2	4,796	49	16.7	14,704	3.2	51.1	6,908	24.0

Source: Statistical appendix to Crop Report and related data, Humboldt Project, U.S. Department of the Interior.

Alflafa acreage in the Humboldt Project has ranged from 33 percent of total cropland harvested in 1948 to 80 percent in 1955 and 96 percent in 1961. This large variation is mainly due to low-water years and grain crop failures for the area in 1955 and 1961. During the two latter years, total cropland harvested decreased. Since 1939, about one-half of the annual acreage has been in alfalfa.

Yields of barley, wheat and alfalfa have been very inconsistent; in some years no barley or wheat was harvested because of climate and moisture conditions.

Corn silage and sugar beets are increasing in importance in the area (see photographs 22 and 23). Alfalfa seed has been grown for several years, but has not shown much increase in acreage. Crop acreage and yields for certain specific years for the Humboldt Project were as follows:

Acreage harvested, 1963-1964

Crop	1963 Acres	1964 Acres
Corn silage	487	1,443
Sugar beets	360	1,550
Alfalfa hay	15,310	14,704
Alfalfa seed	494	637
Wheat	6,100	4,796
Oats	165	19
Barley	1,242	2,372
Safflower	7	-----
Total	24,165	25,521

Crop yields, 1963 and 1959-1963 average

Crop	1963 Tons	1959-63 average Tons
Wheat	1.48	1.32
Oats	.6	1.13
Barley	1.23	1.16
Alfalfa hay	3.4	3.05
Alfalfa seed	.2	.19
Corn silage	23.7	18.35
Sugar beets	20.2	18.30
Safflower	1.4	-----

Sources: 1963 Statistical Appendix to Crop Report and related data and Pershing County Water Conservation District.

At present, sugar beets grown in the area are contracted through Spreckels Sugar Beet Company at Manteca, California, and shipped by rail to the factory there for processing.

Photograph 22. - Harvesting corn for silage, lower Lovelock Valley. SCS PHOTO 6-863-9

Photograph 23. - Example of large sugar beets, 1964 harvest, upper Lovelock Valley. Sugar beets are becoming an increasingly important crop in the Lovelock cropland area. SCS PHOTO 6-870-11

The Lovelock Sub-Basin usually has a surplus of alfalfa hay (see photograph 24). Generally this surplus has been shipped to California and used as dairy feed, or pelleted there and exported to foreign markets. Wheat has also been shipped to California for foreign export. Presently, barley and corn silage grown in the sub-basin are utilized by local cattle feeders.

Photograph 24. - Baled alfalfa hay in a stackyard, Lucky Land & Livestock Company, Lovelock Valley. FIELD PARTY PHOTO 6-868-11

Photograph 25. - Cattle wintering on corn stubble aftermath. Lower Lovelock Valley, looking east toward the West Humboldt Range. FIELD PARTY PHOTO 6-868-4

Livestock Production

From 1939 to 1959 cattle and calves on farms in Pershing County increased from 7,175 to 38,299 head. This increase was greater than any occurring in other counties in the Humboldt River Basin over this period. One reason for this increase was an augmented supply of irrigation water acquired through the purchase of land and acquisition of water rights in the Battle Mountain basin in 1935, and the subsequent development of haylands in Lovelock Valley. In addition, about 1950, farmers in the lower valley established a system providing good quality water from the Oreana area. These improvements in water and feed supply led to the development of several large feeder cattle operations (see cover photograph). After the water rights were transferred to the Lovelock area, the land at Battle Mountain was used as summer pasture for cattle from the Lovelock farms. The added irrigation water enabled farmers to increase their production of feed, in the form of hay, aftermath grazing, and irrigated spring, summer, and fall pasture. However, a few ranches having holdings in the northeast corner of the county have large herds of cattle. This area is not in the sub-basin; for this reason, cattle numbers in the sub-basin were much smaller than for the county. These cattle numbers, based upon 1964 Bureau of Land Management grazing licenses for sub-basin ranches, were estimated at 8,800 head. Livestock numbers fluctuate seasonally, and therefore are difficult to determine. As previously mentioned, there is a number of cattle over and above those licensed which are fed out on the private lands in the sub-basin. Others use these lands for year-long pasture. In addition, animals from other areas are wintered here (see photograph 25).

Some farmers feed cattle to slaughter grades, while a few larger operators feed to finished grade. All cattle fed in these operations are sold and shipped outside Pershing County for butchering. Feeding capacities range from a few to 15,000 head.

There were no farms classified as dairy in Lovelock Valley in 1959, although 21 farmers reported income from dairy products sold. Dairy cattle reported in the 1959 census were primarily of the dual-purpose type, with the exception of one farmer with about 450 head of dairy heifers raised as replacements for the California market, and 21 farmers with a few dairy cows each.

Sheep numbers have fluctuated greatly over the past 25 years, reaching a peak of 7,193 head in 1954 and decreasing to 3,391 in 1959. Numbers of cattle and sheep on farms in Pershing County from 1939 to 1959 and estimated numbers for the sub-basin for 1964 were as follows:

	Pershing County 1/					Lovelock Sub-Basin 2/
	1939	1944	1949	1954	1959	1964
	Head					
Cattle and calves	7,175	13,445	12,097	27,727	38,299	16,000
Sheep and lambs	4,341	6,439	4,943	7,193	3,391	2,500

Source: 1/ U.S. Census of Agriculture. 2/ Humboldt River Basin Field Party.

Cattle and calves sold alive in Pershing County followed a trend similar to that of cattle and calves on farm, increasing from 3,230 head in 1939 to 22,742 in 1959. Sheep and lambs sold alive fluctuated from a low of 2,607 in 1944 to a high of 5,129 head in 1954. In 1959, 4,450 sheep were sold alive; this was more than the number on farms, indicating a reduction of sheep inventory on farms.

Livestock Marketing

According to University of Nevada Bulletin Number 224, there were 37,787 head of cattle and calves shipped from Pershing County in 1959. The major classes of cattle shipped were steers, 50 percent; heifers, 23 percent; cows, 12 percent; and 15 percent miscellaneous. Of the total number, 27,937 head were reported shipped to specific destinations, and 9,850 head to unknown destinations. California packers and feeders received 66 percent of these cattle, while 33 percent were shipped to other counties within the State of Nevada. Only one percent was shipped to States other than California or Nevada.

The majority of livestock are contracted for purchase prior to sale time. Cows, bulls and small lots of other cattle classes are often sold at auction or to local buyers. The auction at Lovelock provides a convenient market for ranches producing small numbers of livestock.

A study by the University of Nevada shows that California market demands for all in-shipments of cattle have grown over a 20-year period (1940-1959) at 3.75 percent per year, but Nevada shipments to California over the same period have increased only 2.34 percent per year for all classes. During post-war years (1947-1959) there was only a slight increase in numbers shipped for combined slaughter and stocker-feeder purposes. The number of cattle shipped to California for immediate slaughter decreased, up to the year 1959, mainly through changes in grade demanded by California packers. Since that time this trend has been reversed, at least for this sub-basin, primarily because of feeder operations in Lovelock Valley.

Pershing County farmers were the only cattlemen in the Humboldt Basin shipping fat cattle. Present indications suggest more feeding will very likely take place in the area in the future, thus increasing the value of the products sold and farm incomes in the sub-basin.

Transportation

Trucks transported 96 percent of all cattle leaving Pershing County in 1959. According to University of Nevada Bulletin Number 224, just over three percent (3.2) were conveyed by rail, and .8 percent were unknown.

Several motor freight common carriers maintain terminals in Winnemucca, Lovelock, and Fallon, and provide interstate service to all parts of the nation. Some local carriers provide intrastate service. California truck carriers also transport livestock from the sub-basin.

Transportation facilities available to sub-basin ranches are adequate. Southern Pacific, an interstate railroad, traverses the sub-basin, and provides daily schedules to the West Coast and eastern points. This railroad offers livestock transportation service, with loading facilities at Winnemucca and Lovelock. Another east-west interstate railroad, Western Pacific, swings north of the sub-basin at Winnemucca, but offers livestock transportation service to sub-basin ranches, with loading facilities at Winnemucca and Gerlach.

Transcontinental U.S. Highway 40 (Interstate 80) links the sub-basin with eastern and western points, and U.S. Highway 95 at Winnemucca provides access to southern Oregon and Idaho (see photograph 26). U.S. Highway 95 also provides access to Fallon and points south. Nevada State Highways 48, 50, 59, and 66 serve portions of the sub-basin. During good weather, numerous other roads and truck trails provide access to most parts of the sub-basin.

WATER-RELATED PROBLEMS IN THE SUB-BASIN

Agricultural Water Management

Soils

The principal cropland problem soils are in areas with a high and fluctuating water table. In these locations drainage is inadequate, with poor outlet conditions, and salt and alkali concentrations are the highest. (See Soils, General Sub-Basin Characteristics.)

Water released from Rye Patch Reservoir during the irrigation season is, in general, a medium to high salinity and a low to medium sodium hazard water. It contains approximately 600 to 900 parts per million total dissolved salts, in which 50 to 60 percent of the cations consist of sodium, and 45 to 70 percent of the anions are bicarbonates. The quality of water changes from year to year, depending on the amount of carryover storage in the reservoir at the end of the water year, and the quantity of inflow to the reservoir during the year.

Continued use of water of the quality generally available for irrigation to Lovelock Valley requires adequate soil drainage and leaching to maintain a favorable salt balance in the soils. Quality of the river water downstream from Lovelock progressively deteriorates because of return flows from irrigation. Below the lowest diversion, the water is of doubtful to unsuitable quality for irrigation.

Photograph 26. - Looking southward along U.S. Highway 40 (Interstate 80), 'Mainstreet of the Nation', north of Mill City, with cloud-capped Star Peak and the Humboldt Range in the background. Through the Lovelock Sub-Basin, U.S. Highway 95 shares the same routing with U.S. 40; by means of these two important through highways, the sub-basin is linked with eastern, western, northern and southern points. FIELD PARTY PHOTO 6-652-3

Photograph 27. - Digging a drain by dragline, lower Lovelock Valley. SCS PHOTO 6-685-12

Seepage Loss

The present irrigation water distribution in Lovelock Valley is carried out through six main canals, plus numerous laterals. The canals, as well as the laterals, are often closely paralleling; none are lined.

Investigations by the Bureau of Reclamation, as reported in the Humboldt Project Nevada, 1952, indicate excessive seepage from some of the major canals. This seepage, along with downward percolation from excess irrigation water used for leaching, causes the water table to rise during the irrigation season. There is a need for consolidation of some of the canals and laterals, as well as lining through sections with highly permeable soils.

Drainage

Drainage problems in Lovelock Valley started with irrigation development. Under natural conditions a very high water table developed during the relatively short irrigation season, and then receded to normal as the spring flows subsided. The construction of Rye Patch Dam made water available, in most years, for the entire growing season, and created an incentive for intensive irrigated land development. As a result of these improvements, a more persistent and widespread high water table developed, which in turn caused an unfavorable salt balance in the soil. Deep drains, constructed to correct these conditions, have generally been successful (see photograph 27). There remains, however, a considerable area in the lower valley, and small scattered areas in the upper valley, where the drainage is imperfect, and an intermittent high water table and an unfavorable salt balance condition still exists.

Studies at the University of Nevada, as reported in Water Table Fluctuation Effect on Alfalfa Production, by Rhys Tovey, indicate that frequency and duration of water table fluctuations must be controlled to sustain alfalfa production. In this study it was found there was a decrease in plant growth and yield as the period of waterlogging increased from four to 11 days. In similar studies at the University good yields were obtained when the water table was held static at either two, four, or eight foot depths. It is assumed that the quantity of salt concentration in the soil or irrigation water would have some effect on yields in areas with shallow water table; as an example, two to four feet.

Irrigation Efficiency

On-the-farm irrigation efficiency (amount of water required to bring soil in the root zone to field capacity, divided by the amount of water applied) is variable throughout the sub-basin. In Lovelock Valley the efficiency is estimated to vary from 25 to 70 percent, depending on the type of management used and the soil problems involved.

It is necessary to apply water in excess of that required for plant growth, to leach harmful accumulations of soluble salts in the soil. Adequate drainage is a prerequisite in this leaching.

Water Control

The large heads of water used to irrigate the fields cause erosion in some ditches and in the fields below the turnouts. Ditch lining and additional turnouts and drops are needed for better water control.

Flood Damage

During the 104-year period (1861-1965) of the white man's settlement and sustained exploitation of the Lovelock Sub-Basin, it has been subjected to recurrent flooding or periods of high water. Prior to the completion of Rye Patch Dam in 1936, both flood types - wet-mantle and dry-mantle - were destructive, in terms of recorded flood, erosion, and sediment damage.

Since Rye Patch Dam and Reservoir became operative, that portion of the sub-basin below the dam, and particularly Lovelock Valley, has not been directly subject to wet-mantle flooding. Flood damage there now occurs only as the result of infrequent heavy overflow spillage from the reservoir. This spillage occurs when reservoir storage capacity is exceeded by high water inflows. The releases of this surplus water may result from wet-mantle floods in the Humboldt Basin above Rye Patch, or may be the culmination of a series of high storage years which causes the reservoir capacity to be exceeded.

The installation of Rye Patch Dam had no effect on the occurrence of localized severe dry-mantle flooding in the sub-basin.

Further details of flood damages in the sub-basin are contained in the Field Party's Chronology of Flood Years and High Water Years, 1861-1962.

The wet-mantle flood results from the complete saturation of the soil mantle, to the point of overland flow. This condition is brought about by extended periods of warm winter rain, rain-on-snow or frozen ground during the winter months, or the rapid melting of abnormal snow accumulations in the spring.

The dry-mantle flood is primarily a summer occurrence, resulting from relatively short periods of heavy rain from summer thunderstorms on dry soils with a thin or depleted vegetal cover, whereby the soil mantle is only superficially wetted by the beating rain.

The dry-mantle type occurs less frequently along the Humboldt, and is usually confined to the stream sources on the higher watersheds, although it often can cause - and in this sub-basin quite frequently has caused - severe localized stream damage. Through the years, this flood type has inflicted extensive cropland damage and sedimentation. Flooding has damaged the Central and Southern Pacific Railroads, the Nevada Short Line from Oreana to Rochester, U. S. Highway 40, and the towns of Dun Glen, Rochester and Lovelock.

Wet-Mantle Floods

December 1867 - January 1868. - The earthen dam of the Utica Bullion Mining Company at the natural drain of the Humboldt lakes through the Humboldt dike was completely washed out. Although the dam was quickly rebuilt, this put the company's stamp mill at the dam site out of business for several years, because the Humboldt lakes from 1868 to 1874 did not supply sufficient amounts of water to operate the mill.

January 16-19, 1875. - Starting on January 19, rain on three feet or more of new snow in the East Range above Dun Glen caused extensive flooding and heavy sheet and gully erosion. Torrents of mud and rocks poured out of almost every canyon at the north extremity of this range.

June 1876. - The breakup of the rigorous winter of 1875-1876 caused some flooding in the lower portion of the Lovelock Sub-Basin, particularly at the Humboldt lakes.

Their level was raised to such an extent that the overflow through the drain in the Humboldt dike again washed out the Utica Bullion Mining Company's mill dam, which was not rebuilt until the following spring.

May-June 1884. - Melting of abnormally heavy snow accumulations from the winter of 1883-1884 began to produce wet-mantle flooding along the entire Humboldt main stem by May 1884. In the Lovelock Sub-Basin, this wet-mantle high water in the Humboldt was augmented by dry-mantle flooding in June from the canyons of the Humboldt, Trinity, and Ragged Top Ranges. The combination of the two flood types caused flooding and damage along the lower Humboldt west of Winnemucca which was hardly to be equalled or exceeded, even in 1910.

This damage ran the gamut from destruction of all road bridges over the Humboldt, from Humboldt House southward, to the marooning of passenger trains on the Central Pacific between Mill City and Oreana. An emigrant train was caught by Trinity Range floodwaters at Granite Point, immediately south of Lovelock. Also, for the third and last time the Utica Bullion Mining Company dam at the Humboldt dike was destroyed. The destruction this time was not directly flood-caused, but was flood-induced. The dam, which when rebuilt in the spring of 1877 had been reinforced with 800 tons of rock, held all too well against the surging waters of the Humboldt lakes drain. The rapidly rising lakes were forced back into the lower Lovelock Valley farm lands, inundating 1,000 acres of grain and alfalfa, and threatening to flood much additional arable land in the lower valley.

Legal action was started in the Federal Court at Carson City to abate this nuisance. However, some of the ranchers, aided and abetted by the worried railroad company from all indications, on the night of June 24 surprised and overpowered the guard at the dam and mill, and blew up the dam. It was never rebuilt.

The Marzen & Harrison diversion dam on the Humboldt at Lovelock was weakened by the swollen river, but held. The headgates of the Southwest (Marzen) Ditch at the dam were damaged. The following summer and fall Colonel Marzen strengthened his dam, at this time the second permanent diversion structure in the valley, by rip-rapping it with 3,000 tons of rock.

March-June 1890. - The breakup of the "White Winter" of 1889-1890 led to system-wide flooding along the Humboldt River in the spring of 1890. The Lovelock Valley irrigation installations and diversions were particularly hard hit. Of the five permanent irrigation diversions installed in the Humboldt channel at that time - Young, Pitt-Hauskins, Irish-American, Marker, and Marzen - two were washed away: the Pitt Dam and the Marker Dam (see photograph 6). The Irish-American (Last Chance) Dam between these two structures was not washed out or appreciably damaged, perhaps because of its being constructed on the solid foundation of the old Hill Beachey stage road ford over the Humboldt River.

Loss of life occurred in this flood period when Arthur Kewley, a Lovelock farmer, was drowned while attempting to cross his flooded fields on horseback during the flood peak.

March 1910. - A system-wide flooding of the Humboldt, which was brought on by extended periods of warm rains on heavy snow or frozen ground from February 27 to March 5, wreaked great damage or destruction on all the Lovelock Valley diversions and canal systems except the one farthest upstream - the Young Dam at Woolsey. The remaining six

(Pitt, Irish-American, Marzen, Rogers, Union, Big Five) were all washed out. After the Pitt diversion and canals, which had just been rebuilt at a cost of $30,000, were washed over by a seven-foot head of water, the resultant freshet along the Humboldt channel took out all bridges and structures below.

The Big Five diversion dam and reservoir, at that time the largest of such structure in the State of Nevada, cost over $25,000. With its destruction, all the lands under the Big Five Canal were deeply inundated.

All the washed-out diversions were rebuilt later that year except the Marzen and Union structures, which were abandoned (see Settlement).

February 1914. - Heavy snows and rains fell over California and Nevada, climaxed by the storm of January 23-26. On the Humboldt, this brought heavy rains and consequent flooding from the lower slopes and elevations, from Elko west to Lovelock. In the Lovelock Valley, the high waters of the Humboldt on February 14 again brought trouble to the Big Five reservoir and diversion, in the form of a 50-foot break in the reservoir's west levee. The floodwaters thus released inundated four farms below the dam.

March-June 1932. - Melting of the heavy snowpack in the Humboldt Basin, from Reese River westward, caused flooding along the lower Humboldt, particularly in Lovelock Valley. The Big Five Diversion again washed out; it was only partially reconstructed (see Settlement).

April-May 1942. - In this flood period Rye Patch Reservoir and the Pitt-Taylor Reservoir both filled for the first time since completion of Rye Patch Dam in 1936, and kept the bulk of the floodwaters away from Lovelock Valley. However, the spillage from Rye Patch Reservoir was heavy enough to cause partial failure of the Young Dam which in turn probably caused the destruction of the Rogers Dam. The Young Canal, and its flume across the Humboldt River, were also damaged. The Rogers Diversion was not rebuilt until 1946.

April-June 1945. - Although not generally considered a flood year along the Humboldt River, 1945 was one of the high water years verging on the flood year category. Coming as the culmination of a group of back-to-back wet weather years in the Humboldt Basin, it caused Rye Patch Reservoir to reach its capacity early in the spring, leading to a relatively lengthy period of the spilling of surplus water.

This sustained spillage period caused downstream damage in Lovelock Valley, particularly to the levee system along the west side of the Big Five Diversion. Humboldt Lake was swollen beyond the capacity of the deepened natural drain through the Humboldt dike. This resulted in an encroachment of the lake on irrigable lands in the south and west portions of the lower valley.

April-May 1952. - Again, as in 1942, because of the flood protection afforded by Rye Patch Dam and the Pitt-Taylor Dams, anticipated extensive damages in the Lovelock Valley failed to materialize from this system-wide wet-mantle flood along the Humboldt. However, there were damages to headgates at the Pitt-Taylor Dams, severe damage to the Big Five diversion levees, and damage to many smaller diversion gates in Lovelock Valley.

During May 1952 the upper six miles of the Big Five levee not restored or improved after the 1945 flood damage were raised and strengthened by the Pershing County Water

Conservation District and private interests.

Also in 1952 the Corps of Engineers constructed an emergency dike 3.1 miles long to prevent encroachment of Humboldt Lake northward onto irrigable land. At the same time a pumping plant was constructed to move the irrigation runoff and drain water through this dike to Humboldt Lake.

Dry-Mantle Floods

July 23, 1876. - Several localized but severe dry-mantle floods emanated from the canyons of the Humboldt Range during the afternoon and evening of July 23. One occurred just east of Mill City, washing out one-fourth mile of Central Pacific main line. Another occurred west of that place, inundating the Humboldt bottom and drowning several head of horses and cattle.

August 15, 1878. - Cloudbursts in the Humboldt Range washed out the Central Pacific main line at scattered points between Winnemucca and Lovelock, delaying train service about four hours.

June 5-15, 1882. - Flooding similar to that of 1878 again damaged the Central Pacific Railroad. The most serious break occurred at Oreana on June 12. A section of the railroad was washed away, delaying all train movements from six to eight hours.

June 1-20, 1884. - Previously discussed under the wet-mantle caption. The year 1884 is of note in the flood history of the Humboldt Basin because of the occurrence that year of both flood types. Frequently, one type augmented or aggravated the other.

August 1890. - A cloudburst in the Humboldt Range washed out a portion of the Central Pacific line between Humboldt House and Rye Patch. A short delay to train movements ensued.

July 18-25, 1913. - A series of daily severe thunderstorms during this period caused widespread but localized havoc in the sub-basin. Dun Glen was flooded; damages estimated at $16,000 were inflicted, including destruction of the hotel and Oastler cyanide mill, along with several residences.

June 18-22, 1918. - This flood period, one of the most damaging in the history of Humboldt dry-mantle floods, caused great damage to roads and buildings in Upper and Lower Rochester. The roadbed of the Nevada Short Line Railroad between Oreana and Rochester was almost completely destroyed, and one man narrowly excaped drowning in Lower Rochester. Road and irrigation ditch damage occurred near Rose Creek, and ranch buildings at the mouth of that stream were damaged. Silt deposition, mud-rock flows over meadows, and stream channel cutting were widespread and severe along the Humboldt between Rose Creek and Lovelock.

August 12-13, 1961. - U.S. Highway 40 was damaged between Woolsey and Mill City by mud-rock and water flows from adjacent canyons in the Humboldt Range. Over 600 acres of cropland in the upper Lovelock Valley northwest of Lovelock were damaged by sedimentation from floodwaters off the Trinity Range.

June 18, 1963. - A severe summer convection storm falling in the Trinity Range northwest of Lovelock sent water funnelling down the drainage south of Trinity Canyon. It covered over 500 acres of cropland in the upper Lovelock Valley, in particular that of

the Leidich farm, with mud, rocks and debris. It washed under the Leidich residence, across the farmstead, and dumped into an old river channel, where it washed out a bridge.

This same freshet also caused considerable washing and deposition damage to U. S. Highway 40 (Interstate 80) south of Lovelock. The Nevada Department of Highways spent approximately $3,000 on repair and cleanup along the highway following the storm.

Vegetal Conditions

Range and Watershed

Range and watershed conditions in the Lovelock Sub-Basin are deteriorated, and the rangelands are generally producing far below their potential. As an exception to this generally widespread poor or depleted range condition, a few relict areas in either the medium or fairly high forage production classes may yet be found in the East and Humboldt Ranges.

Eighty-nine percent of the sub-basin is in the low forage production class, three percent in the medium, and less than one percent in the fairly high. Table 2 indicates the acreage by classes of present annual forage production, grouped by soils for each vegetal type and site. The rates in this table are indicative of the total annual forage production, and will be used as a basis for planning needs only. Forage production figures of themselves cannot be used for assigning range carrying capacities. Determination of these carrying capacities would also need to consider such factors as slope, soil depth, soil character and stability, and the management objectives of the owners or administrative agencies.

Heavy use of the rangeland resources, more particularly from before the turn of the century to the 1940's, has seriously depleted the better range forage species. This use started with the emigrant travel, then was followed by the extensive freighting and staging operations incident to the mining development in the sub-basin, which lasted from the 1860's until well after the turn of the century, and concluded with grazing by transient sheep bands and year-round cattle use. In recent years, grazing has been somewhat reduced, but the range remains generally in a critical condition.

Only in the least accessible and remote areas are the better forage species, such as Idaho fescue, Nevada bluegrass, Cusick bluegrass, mountain brome, and oniongrass, still to be found (see photograph 15). Where the loss of perennial cover has occurred, there is evidence of slight to severe sheet and gully erosion. Pronounced erosion has occurred in the north half of the sub-basin along the stream courses of the East Range, particularly Raspberry and Dun Glen Creeks, and in Rockhill Canyon (see photographs 28 and 29). In some instances, there has also been from moderate to severe wind erosion as a result of the removal of vegetal cover by fire. This is evidenced by the 1963 burn area along U.S. Highway 40 in the vicinity of Rose Creek (see photograph 8).

Areas in the medium or fairly high forage production classes are in the juniper stands of the East Range, the north slopes of Star Peak in the Humboldt Range, and a relatively small grassland area on the bench to the north and east of the Humboldt House.

The once widely spread winterfat stands on Dun Glen Flat and the flat lands to the north of the backwaters of Rye Patch Reservoir, as well as in the vicinity of the old Lassen Trail and the Arabia-Poker Brown Flat road, show evidence of moderate to severe sheet and gully erosion. These stands of winterfat are being invaded by the poisonous weed

Photograph 28 - Severe Class 3 gully erosion on lower Raspberry Creek, East Range.
FIELD PARTY PHOTO 6-851-2

Photograph 29 - Class 3 gully erosion, Rockhill Canyon, East Range, 12 miles east of Halfway Station on U.S. Highway 40.
FIELD PARTY PHOTO 6-851-8

halogeton, and less desirable browse species such as shadscale and bud sagebrush. (See photograph 30.)

The shadscale and bud sagebrush types west of Rose Creek and on the benchlands east and west of Rye Patch Reservoir have practically no desirable grasses or forbs present (see photograph 11). There is slight to severe gully erosion in most of these shadscale stands, particularly on the fans west of Rye Patch Reservoir.

Photograph 30. - Because of heavy grazing pressure, the white sage type in the middle distance is being invaded by the less desirable shadscale type in the foreground. Southwest of Dun Glen Creek on the low divide at the head of Buena Vista Valley south of Mill City, looking northeast toward Auld Lang Syne Peak in the East Range. FIELD PARTY PHOTO

In the southern half of the sub-basin, from Oreana southward to the rim of the Humboldt Basin where the natural dike rises south of Toulon and Humboldt Lakes, range and watershed conditions are no better than in the north portion (see photograph 31). In fact, they are worse, if possible. Watershed cover on the Trinity and West Humboldt Ranges, never luxuriant even when in pristine condition, has deteriorated to such an extent during the white man's tenure that not only are most of the larger canyon bottoms actively gullied, but also the shortest and shallowest stream courses. This has led to extensive dry-mantle flooding and cropland damage on the west side of Lovelock Valley.

In the West Humboldt Range, every drainage contributes its load of silt, rocks and flood debris after even moderate storms. At the southern extremity of the Humboldt Range, frequent flooding in Limerick and Rochester Canyons since the first dry-mantle floods in 1918 has caused heavy loss and destruction to roads, railroads, and other improvements (see Flood Damage).

Photograph 31. - The ultimate in poor range condition. Winter range cattle attempting to forage on unsuitable, sparsely vegetated playa, semi-playa, and shadscale sites south of Humboldt Lake, immediately north of the natural dike. Looking easterly, toward the steep, barren slopes of the West Humboldt Range's southern extremity. FIELD PARTY PHOTO

Photograph 32. - Fremont cottonwoods, hauled in from the lower Carson River and planted early in the white man's agricultural development of Lovelock Valley, now form welcome shade and protection along many of the Valley's lanes, roads, and irrigation ditches, as well as around farmsteads. In more recent times various species of elm and poplar have been favored over the cottonwood. Summer scene along a lower valley farm road, south of Lovelock.

FIELD PARTY PHOTO 6-868-3

Phreatophytes

The total area occupied by all phreatophytes is approximately 140,000 acres, or 13 percent of the sub-basin. It is estimated that all phreatophytes are using 39,000 acre-feet of water. Of this total, 35,100 acre-feet are used by nonbeneficial phreatophytes, and 3,900 acre-feet by beneficial. Location of the major phreatophytic areas is described under General Cover Types. Table 3 indicates the acreage and water use of the phreatophytes in the sub-basin.

Immediately north of the Lovelock Valley, the phreatophytes of low economic value consist of many species. Generally, black greasewood is the most common, and

varies from a stunted shrub one to two feet in height on the benchlands to a bush at least four feet high on the river floodplain (see photograph 12). Other low economic value phreatophytes occurring with greasewood, but occasionally appearing as the dominant species, are rubber rabbitbrush, smallflower tamarisk (salt cedar), alkali seepweed, willow, saltgrass, and quailbrush. Small stringers of Russian olive (Eleagnus angustifolia) are found in scattered localities along the Humboldt bottomlands below Rye Patch Reservoir.

Phreatophytes of significant economic value occurring with greasewood and other shrubs are Great Basin wildrye, creeping wildrye, fourwing saltbush, and Nuttal's saltbush.

Shadscale and bud sagebrush frequently form an understory to the greasewood stands in the Rye Patch-Oreana area. In these stands, shadscale and bud sagebrush are not phreatophytic, but the greasewood very likely is, although the water table in these locations must be at least 20 feet or more in depth.

Various species of cottonwood, poplar, and elm occur along the roadsides, ditches, and around farmsteads in Lovelock Valley (see photograph 32). These tree species are all phreatophytic, and all have been introduced into the area. They are using approximately five acre-feet of water per acre annually. Total acreage of trees in the valley is estimated to be approximately 100 acres, and their total use of water would be 500 acre-feet, which is negligible compared to other uses. Use of water by these trees is considered to be beneficial, because of their aesthetic value, their protection of cropland areas from desiccating winds, and the shade and cover they provide for songbirds, upland game birds, and other wildlife.

Willows, buffaloberry, and tamarisk generally line the Humboldt River from Rose Creek to Rye Patch Reservoir, and from Rye Patch Dam to Lovelock Valley. Below the dam an occasional Fremont cottonwood can be found along the banks of the river. North of Lovelock Valley, there is very little cropland on the bottomlands of the Humboldt River, in contrast with the river bottomlands and drainages of the other sub-basins. These bottomlands are used almost exclusively for native pasture, and are covered with such phreatophytes as greasewood, rubber rabbitbrush, alkali sacaton, saltgrass, creeping wildrye, Great Basin wildrye, quailbrush, and wiregrass (Juncus spp.).

Big sagebrush is also found throughout the Humboldt River bottomlands. Judging from its healthy growth, coupled with its location near or adjacent to the Humboldt channel, there is a possibility of big sagebrush being phreatophytic, as was the case along the upper reaches of Reese River in the Reese River Sub-Basin, and in scattered locations throughout several of the upper Humboldt sub-basins.

In Lovelock Valley, phreatophytic greasewood and salt cedar, with a scattering of rubber rabbitbrush, fourwing saltbush, and silver buffaloberry, comprise the principal overstory species in the semi-playa and saline wet meadow sites fringing the irrigated lands. Greasewood and salt cedar also form overstories on the semi-playa, alkali flats, and saline wet meadow sites bordering the Humboldt lakes and playa areas, between the Lovelock cultivated lands and the Humboldt dike. Saltgrass forms the principal understory to the greasewood or salt cedar, in varying degrees of ground cover density.

On some areas of extreme alkalinity and salinity, as on portions of the alkali flats site east of Humboldt Lake and north of Toulon Lake, almost pure communities of pickleweed grow, to the practical exclusion of any other species.

Table 2. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Lovelock Sub-Basin

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
1. Semi-playa-greasewood-pickleweed; alkali bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	-----	-----	0-50	-----	-----	0-50	
A6-R4	-----	-----	9,700	-----	-----	9,700	Proper management and stocking.
A6-R4-Y2	-----	-----	9,400	-----	-----	9,400	
Subtotal	-----	-----	19,100	-----	-----	19,100	
2. Salt cedar-greasewood-saltgrass; wet saline bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	-----	-----	25-100	-----	-----	25-100	Proper management and stocking.
A6-R4-Y2	-----	-----	600	-----	-----	600	
H4-H3-A6	-----	-----	8,600	-----	-----	8,600	
Subtotal	-----	-----	9,200	-----	-----	9,200	
3. Salt Cedar-greasewood; alkali flats	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	-----	-----	25-100	-----	-----	25-100	
A6-R4	-----	-----	9,200	-----	-----	9,200	Proper management and stocking.
H4-H3-A6	-----	-----	26,500	-----	-----	26,500	
Subtotal	-----	-----	35,700	-----	-----	35,700	
4. Rabbitbrush-greasewood-grass; saline bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	850-1,500	200-900	20-300	850-1,500	200-900	20-300	
A4-A6-H6-R4	-----	-----	10,000	7,500	2,500	-----	Brush removal by blading, streambank and channel stabilization, proper management and stocking, and cross-fencing.
A9-R4	-----	-----	7,600	5,000	2,600	-----	
A9-R4-S16	-----	-----	4,600	-----	2,600	2,000	
A10-R4-Y2	-----	-----	6,700	2,000	1,000	3,700	
H4-H3-A6	-----	-----	6,400	2,000	2,400	2,000	
R13-L10-B1-C2	-----	-----	300	-----	300	-----	
S2-R2-A7	-----	-----	4,500	-----	2,500	2,000	
S6-L3-B3	-----	-----	700	-----	700	-----	
S7-A8-G1	-----	-----	500	-----	500	-----	
S7-D1-G1	-----	-----	300	-----	300	-----	
S12-A2-G1	-----	-----	300	-----	300	-----	

Continued

Table 2. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Lovelock Sub-Basin -- Continued

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
4. (Continued)	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
	850-1,500	200-900	20-300	850-1,500	200-900	20-300	
S16-A9-R4	-----	-----	1,200	-----	600	600	(See previous page.)
S16-R9-A7	-----	-----	3,800	-----	1,800	2,000	
S16-R9-A7-G1	-----	-----	4,300	-----	2,300	2,000	
Subtotal	-----	-----	51,200	16,500	20,400	14,300	
5. Shadscale-grass; droughty desert uplands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	100-350	50-150	10-70	100-350	50-150	10-70	
A6-R4	-----	-----	6,400	-----	3,000	3,400	Fencing, stockwater development, streambank and channel stabilization, erosion-proofing of roads, proper management and stocking.
A9-R4	-----	-----	16,400	-----	10,000	6,400	
A9-R4-S16	-----	-----	16,700	-----	5,000	11,700	
A9-S16-R4	-----	-----	11,300	-----	7,000	4,300	
A10-R4-Y2	-----	-----	8,700	-----	-----	8,700	
D1-S16	-----	-----	42,000	-----	20,000	22,000	
R5-L3-B4	-----	-----	1,800	-----	1,800	-----	
R5-L3-B1	-----	-----	2,600	-----	2,600	-----	
R5-S9-L12	-----	-----	72,400	-----	36,000	36,400	
R9-L3-S6	-----	-----	1,000	-----	500	500	
R9-L12-S9	-----	-----	12,000	-----	6,000	6,000	
R9-S9-L12	-----	-----	8,400	-----	4,000	4,400	
R13-L10-B1	-----	-----	11,000	-----	7,000	4,000	
S2-R2-A7	-----	-----	47,400	-----	20,000	27,400	
S2-R6-B3-L12	-----	-----	33,000	-----	25,000	8,000	
S6-A8-B10	-----	-----	6,200	-----	4,000	2,200	
S6-L3-B3	-----	-----	8,700	-----	5,000	3,700	
S7-A8-G1	-----	-----	58,500	-----	38,000	20,500	
S7-D1-A7	-----	-----	5,000	-----	1,000	4,000	
S7-D1-A8	-----	-----	62,400	-----	20,000	42,400	
S7-D1-G1	-----	-----	15,400	-----	5,000	10,400	
S12-A2-G1	-----	-----	13,200	-----	6,000	7,200	
S12-D1-A8	-----	-----	18,900	-----	10,000	8,900	
S12-D1-G1	-----	-----	9,000	-----	3,000	6,000	
S16-A9-R4	-----	-----	5,400	-----	1,400	4,000	
S16-D1	-----	-----	11,000	-----	3,000	8,000	
S16-R9-A7	-----	-----	4,700	-----	2,700	2,000	
S16-R9-A7-G1	-----	-----	35,700	-----	17,000	18,700	
Subtotal 2/	-----	-----	545,200	-----	264,000	281,200	

Continued

Table 2. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Lovelock Sub-Basin -- Continued

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
6. Winterfat-budsage-big sage-grass; silty desert flats	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	150-400	50-200	20-150	150-400	50-200	20-150	
A9-R4	-----	-----	1,000	1,000	-----	-----	Fencing, stockwater development, streambank and channel stabilization, erosion-proofing of roads, proper management and stocking.
S2-R2-A7	-----	-----	400	-----	400	-----	
S7-D1-G1	-----	-----	300	-----	300	-----	
S12-A2-G1	-----	-----	500	500	-----	-----	
S12-D1-A8	-----	-----	1,300	1,300	-----	-----	
S16-R9-A7	-----	-----	500	500	-----	-----	
Subtotal	-----	-----	4,000	3,300	700	-----	
7. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	250-600	100-450	20-150	250-600	100-450	20-150	
A9-R4	-----	-----	20,000	5,000	14,000	1,000	Streambank and channel stabilization, erosion-proofing of roads, intensified fire protection, seeding on selective sites, fencing, proper management, stocking, and stockwater developments.
A9-R4-S16	-----	-----	700	-----	700	-----	
A9-S16-R4	-----	-----	500	-----	500	-----	
A10-R4-Y2	3,300	-----	300	3,300	300	-----	
R5-S9-L12	-----	-----	37,800	7,800	25,000	5,000	
S2-R2-A7	-----	-----	700	-----	700	-----	
S2-R6-B3-L12	-----	-----	7,800	1,000	5,800	1,000	
S6-A8-B10	-----	-----	5,600	-----	4,600	1,000	
S6-L3-B3	-----	-----	11,500	3,000	6,000	2,500	
S7-D1-A8	-----	-----	500	-----	500	-----	
S12-A2-G1	-----	-----	4,000	1,000	2,500	500	
S12-D1-A8	-----	-----	31,800	10,000	15,000	6,800	
S16-A9-R4	-----	-----	1,000	-----	1,000	-----	
Subtotal	3,300	-----	122,200	31,100	76,600	17,800	
8. Low sagebrush-grass, claypan benches	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	200-500	100-250	50-150	200-500	100-250	50-150	
R5-S9-L12	-----	-----	13,000	2,000	9,000	2,000	Fencing, stockwater development, streambank and channel stabilization, erosion-proofing of roads, proper management and stocking.
R5-L10-B1	-----	-----	1,300	600	700	-----	
R13-L10-B1-C2	-----	1,900	5,300	4,000	3,200	-----	
S7-A8-G1	-----	-----	1,000	-----	800	200	
S7-D1-A8	-----	-----	3,100	1,000	2,000	100	
Subtotal	-----	1,900	23,700	7,600	15,700	2,300	

Continued

Table 2. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Lovelock Sub-Basin -- Continued

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
9. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	300-650	150-350	50-200	300-650	150-350	50-200	
R5-L3-B4	-----	-----	5,000	2,500	2,000	500	Streambank and channel stabilization, erosion-proofing of roads, intensified fire protection, fencing, stockwater development, proper management and stocking, and seeding on selected sites.
R5-L3-B1	-----	-----	6,400	2,400	3,000	1,000	
R5-L10-B1	-----	-----	38,500	10,000	25,000	3,500	
R13-L10-B1-C2	1,000	22,800	55,700	20,000	45,000	14,500	
S6-A8-B10	-----	-----	1,600	-----	1,600	-----	
Subtotal	1,000	22,800	107,200	34,900	76,600	19,500	
10. Browse-aspen-conifer-grass; steep mountain slopes and basins	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	350-800	200-500	75-250	350-800	200-500	75-250	
R13-L10-B1-C2	2,500	3,100	9,400	11,100	2,500	1,400	Removal of juniper where practical, fencing, stockwater development, streambank and channel stabilization, erosion-proofing of roads, intensified fire protection, and proper management and stocking.
Subtotal	2,500	3,100	9,400	11,100	2,500	1,400	
Total 3/	6,800	27,800	926,900	104,500	456,500	400,500	

1/ These figures indicate total annual forage production (dry weight), and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

2/ Does not include 7,500 acres, barren or inaccessible.

3/ Does not include 21,500 acres in playa around the Humboldt lakes and 16,600 acres covered by Rye Patch Reservoir and Humboldt lakes.

Source: Humboldt River Basin Field Party.

Table 3. -- Phreatophyte acreage and annual ground water use, Lovelock Sub-Basin 1/

	Species	Height class	Density	Acreage cropland	Acreage range types 2/	Annual ground water use 2/ (feet)	Annual ground water use 2/ (acre-feet)
Nonbeneficial	Cottonwood	15'+	.2	-----	100	5.0	500
	Willow	5-12'	.2	-----	200	2.5	500
	Tamarisk	15'	.25	-----	1,200	4.0	4,800
	Tamarisk	6-15'	.08	-----	2,000	2.0	4,000
	Rose	4-8'	.2	-----	100	1.5	100
	Quailbrush	3'+	.04-.07	-----	1,200	.5	600
	Black greasewood	3'+	.03-.09	-----	20,300	.3	6,000
	Black greasewood	3'-	.02-.07	-----	26,200	.2	5,200
	Rubber rabbitbrush	3'+	.04-.12	-----	3,400	.3	1,000
	Alkali seepweed	---	.02-.25	-----	11,900	.5	6,000
	Pickleweed	2'-	.02-.09	-----	1,800	.5	900
	Saltgrass	---	.02-.25	-----	11,000	.5	5,500
	Subtotal				79,400		35,100
Beneficial	Fourwing saltbush	3'+	.03-.05	-----	4,800	.5	2,400
	Great Basin wildrye	---	.04-.12	-----	800	1.0	800
	Alkali sacaton	---	.04-.12	-----	600	.5	300
	Creeping wildrye	---	.04-.12	-----	400	1.0	400
	Subtotal				6,600		3,900
	Alfalfa			15,000		1.0	15,000
	Total			15,000	86,000		54,000

1/ These values when referred to in the text are rounded.
2/ These values are based on natural stand densities and 100 percent composition, for each species, except for the irrigated and wet meadows.

Source: Humboldt River Basin Field Party.

Photograph 33. - Second-growth juniper stand on the site of the original extensive stand which was cut during the Humboldt mining boom of the 1860's and 1870's. At present, these second-growth stands in the East and Humboldt Ranges have little or no commercial value. (East Range in the vicinity of Dun Glen, looking west toward the Eugene Mountains.) FIELD PARTY PHOTO 6-651-3

Timber Management

There are no commercial sawtimber stands within the sub-basin. Extensive stands of juniper in the East and Humboldt Ranges were heavily cut during the Humboldt mining boom period of 1860's and 1870's, and have not recovered sufficiently to be of present commercial significance. (See photograph 33.) Neither the Bureau of Land Management nor the Southern Pacific Land Company, the two largest land owners or managers, contemplates commercial timber cutting on the intermingled public domain or railroad lands, as there are no stands of pinyon or mountain mahogany, or sufficiently large stands of commercially valuable juniper present. The thin, widely scattered aspen stands are most valuable as protection types, or for their aesthetic value and shade.

The checkerboard pattern of intermingled public and private land ownership for most of the sub-basin has had a deterrent effect upon experimental tree planting or the introduction of new species on selected sites. Consequently, neither the Bureau nor the railroad land company has any present or future plans in this respect.

Fire Protection

In the northern portions of the sub-basin, as far south as Rochester, range fires - such as the 1963 Raspberry Fire near Rose Creek - in the immediate past have caused live-

stock losses and watershed damages; they remain an omnipresent threat in those areas. From the Lovelock Valley southward to the Humboldt lakes the stunted, sparse desert browse or tree species, with little or no inflammable cheatgrass understory, afford small opportunity for the spread of wildfire.

In the northern half of the sub-basin, the deterioration or destruction of the original plant cover, whether brought about by fire or other watershed abuse, has increased the fire hazard by providing flash fuels, through the introduction or invasion of more primitive vegetal types. Fires on the steep, brush-covered, thin soiled slopes of the East Range, the Humboldt Range, and the Eugene Mountains could be seriously damaging to these important watershed areas.

RECREATION AND WILDLIFE

Recreation Developments

Little effort has as yet been made toward a planned development of the Lovelock Sub-Basin's recreation potential, with the exception of some development in and around Rye Patch Reservoir (see photograph 34). There exists a strong potential for future expansion in recreation use, particularly in the East Range and the Humboldt Range. As the population buildup continues, and with fuller development of the sub-basin's largely untapped recreation resource, this potential will become more significant.

Photograph 34. - Picnic area developed on the east bank of the Humboldt River, immediately below Rye Patch Reservoir. Looking east, toward the Humboldt Range.

FIELD PARTY PHOTO 6-893-7

Photograph 35. - Hill Beachey Road in vicinity of old Thacker Stage Station, with the Humboldt River, Imlay, and Star Peak in background.

Within or immediately adjacent to the sub-basin boundaries, on both public domain and privately owned lands, there are many points of local, State, or national significance. These are being increasingly sought out by tourists, historians, and hobbyists in general. Some were important during the period of westward migration, such as long, relatively undisturbed stretches of the California Emigrant Trail, and the Applegate-Lassen and Noble Cutoff Trails. The significance of other historic roads stems from the stagecoach-freighting period, such as the remnants of the Chorpenning "mule mail" route and the Hill Beachey Railroad Stage Line, including its Imlay-Idaho freight and stage road (see photograph 35).

Humboldt City, Dun Glen, Star City, and Unionville, as remnants of Nevada's first mining boom north and east of the Comstock in 1861-1862, have at least Statewide significance, and merit additional attention and recognition (see photograph 2). There are others, far too many to enumerate here, such as the Lovelock Indian caves, which were important during these or earlier periods of the sub-basin's history. A fairly complete list may be compiled through perusal of the section on settlement in this report.

Public Domain

Presently, there are no developed camp and picnic areas or any other recreation improvements on these lands. The Winnemucca District of the Bureau of Land Management has recently completed, in connection with the Outdoor Recreation Resource Review (ORRR), an inventory of camp and picnic sites in the East Range and the Humboldt Range, between Winnemucca and Lovelock. (See table 4.)

Table 4. -- Potential developments, Outdoor Recreation Resource Review, 1962, public domain, Lovelock Sub-Basin

Site name and type of development	Acres 1/	Site development cost 2/ (dols.)	Access roads: Miles	Access roads: Construction cost (dols.)	Access roads: Rights of woy acquisition cost (dols.)	Yeorly comp moint. cost (dols.)	Trails: Miles	Trails: Devel. cost (dols.)	Water devel. cost (dols.)	Total devel. cost (dols.)	Area affected acres: BLM	Area affected acres: Other
White Horse Canyon camp ond picnic site (Sec. 16, T. 34 N., R. 36 E.) Primory users - deer hunters from Reno, Lovelock, Winnemucca areas	4 (approx.)	18,000	1	3,500	-----	No estimate	--	-----	Included in site development cost	18,000	320	--
Woolsey Dam comp and picnic site (Sec. 16, T. 28 N., R. 32 E.) Primory users - picnickers from Lovelock, Winnemucco oreos	4 (opprox.)	18,000 to 20,000	1-1/2	5,200	-----	No estimote	--	-----	Included in site development cost	18,000 to 20,000	360	--
Humboldt City comp (Sec. 1, T. 31N., R. 33 E.) Primory users - historians, sightseers, compers, picnickers from out of state, Reno, Lovelock, Winnemucca	6 (approx.)	26,400 (17 comp units)	1	3,500	-----	No estimote	--	-----	Included in site development cost	26,400	320	--

1/ Colculoted on the basis of three comp units per acre.

2/ At the rate of $1,800 per comp unit.

Source: Bureou of Land Monagement, Winnemucca District.

The Winnemucca District is currently searching for new sites throughout the District which have potential for recreation development (see photograph 36). In addition to the recreation sites listed in the table, it is likely that other suitable sites exist in the subbasin. It is expected that all potential recreation sites in the area will be inventoried by July 1967.

At present, no Bureau funds are available for the construction of recreation sites in the Winnemucca District, and no prediction can be made when recreation construction money will be available. It is possible that some of the inventoried sites will be dropped in favor of new sites by the time construction is definitely programmed.

Rye Patch Reservoir Lands

There are at present two boat-launching facilities at Rye Patch Reservoir, located on either side of the dam, approximately one-fourth mile above the structure. These launch facilities and roads were built by Pershing County; some preliminary development on the west launch site was done by sports-minded and boating enthusiasts using privately owned construction equipment. The west side facility has been found to be adequate ex-

Photograph 36. - Cottonwood grove, Humboldt Canyon, immediately above the site of old Humboldt City. Groves such as this in the canyons of the East and Humboldt Ranges represent an important potential for recreation use, particularly when developed in conjunction with a historic site, as here. FIELD PARTY PHOTO 6-867-6

cept under most adverse drawdown conditions. The east side facility, however, is inadequate under heavy drawdown, and becomes inoperative under a situation where only 15,000 acre-feet of storage remain.

A recreation area exists on the east side of the river just below the dam (see photograph 34). This facility was established by the Pershing County Water Conservation District for picnickers. It is also used, however, by overnight campers having tents, trailers, or other camping equipment. There are five camp or picnic units equipped with tables, with a single piped outlet of good quality spring water for the entire campground. This area encompasses approximately one-half acre, with no charge for its use. During peak periods of fisherman use there are as many as 25 camp trailers overflowing from this facility to adjacent areas. On the west side of the Humboldt River, below the dam, there is an area suitable for establishing camping facilities. Some preliminary survey work has been done at this site by various groups, and a potential of 12 to 15 camp units could be developed.

Wildlife

Deer and Other Big Game Hunting

This sub-basin is inhabited by relatively few deer, with the Humboldt Range being the most important deer use area. Other ranges, including the East, Trinity, and Eugene Mountains, maintain very low densities of deer, and accomodate a minimum of big game shooting. Deer concentration areas as such, either winter or summer, do not exist. There is a general shortage of desirable deer forage in the sub-basin, because of past overuse by both big game and domestic livestock. The annual deer kill figures for the region average some 75 animals. This harvest is made up of 60 percent bucks and 40 percent antlerless deer.

Fisheries

Humboldt River

Several plants of brown and black bullheads have been made in the river upstream from Rye Patch Reservoir in the past few years. These were fish removed and transferred from irrigation ditches and river areas where they had become trapped in years of minimal flow. There is only light fishing pressure on these bullheads, even though they are present in fishable numbers, and some good catches are being made above the reservoir in the area known as Callahan Crossing. The Nevada State Fish and Game Commission feels that these species have a high potential for development.

Rye Patch Reservoir

For the second time in its history, in the summer of 1961 all available water was removed from Rye Patch Reservoir for irrigation. That fall the lake was treated chemically, to remove all fish. To rehabilitate the fishery, subsequent plants in 1962 of 42,960 channel catfish, 44,400 largemouth bass, 3,135 crappie and 47,766 trout were made. Because of the lack of competition from carp, the stocked fish, particularly the trout, showed outstanding survival and growth. Prior to the February 1962 flood, it was believed three or more years of good fishing could be realized before carp populations would again build up to where trout could not successfully compete. However, the 1962 floodwaters from the Battle Mountain basin, and the resultant high flows into Rye Patch, accelerated the carp reintroduction from the river into the reservoir.

In 1963 the reservoir provided outstanding trout angling of quality fish from 16 to 20 inches in length. It was the rule rather than the exception for anglers with even minimal competence to leave the reservoir with either their number limit or weight limit of trout. During February, March and April 1963, this water accommodated more angler usage than did all other waters of both Humboldt and Pershing Counties combined.

Some sub-legal sized channel catfish, largemouth bass and crappie are beginning to show in fishermen's creels. In the future, these species should fill the void left by diminishing trout numbers. Under existing ecological conditions, trout survival and growth are too poor to justify stocking Rye Patch reservoir with this species. According to Nevada Fish and Game Commission technicians, however, under proper environmental conditions trout fishing can periodically be brought to a level as high or higher than that which existed in 1963.

No other streams within the sub-basin are stocked; however, two streams in the Humboldt Range do provide limited angling. These streams, Rocky and Eldorado, are extremely small, and became intermittent in flow along their lower reaches toward late summer.

Small Game

The foothills of the sub-basin are prime chukar hunting areas, and maintain good populations of these birds in favorable grass production years. This area provides an annual kill in good years of some 7,000 birds.

The only pheasant populations of any significance are restricted to the cultivated lands of Lovelock Valley, with a few scattered birds being found upriver from the valley to Rye Patch Dam. Pheasant hunts are of short duration, because of the conflict of land use, and are usually limited to five days. Most of the Lovelock Valley ranchers are cooperating in the use of their lands by hunters. The valley accommodates relatively large numbers of hunters, even though the hunts have been held when many thousand head of cattle were grazing in the fields or in feed yards. The 1963 hunt provided a harvest of 3,796 cocks, affording 2,080 hunter days of shooting recreation. A supplemental release of pheasants is made annually to provide increased hunting, which in turn increases the density of hunters per unit of land open to hunting.

Good populations of California quail inhabit the sub-basin. The entire river bottom is utilized by the quail, with greatest and most stable populations in the irrigated valley around Lovelock. At intermediate elevations, quail are restricted to canyon bottoms, where suitable food and cover are found adjacent to water. The entire sub-basin provides an annual harvest of some 2,000 quail, for approximately 900 hunter days.

Waterfowl shooting is determined by availability of water in Humboldt and Toulon Lakes. When water conditions are sufficient for nesting and resting, good to outstanding wildfowl production and fall concentrations are found on the lake area, including ducks, geese, and other aquatic species. These fall populations will vary from approximately 1,000 to as many as 120,000 birds. The lakes are rich in aquatic growth of high quality food plants, such as nut grass (Scirpus spp.) and pond weeds (Potamogeton spp.). Periods of drought and lack of water have an adverse effect on these plants and two years of good water conditions are necessary to bring back abundant growth of these food plants for waterfowl. At present, the Nevada Fish and Game Commission, through leases of Bureau of Reclamation and Southern Pacific lands, provides free access to waterfowl shooters.

Cottontail rabbits within the sub-basin are a neglected game species; they could provide much more hunting pleasure than they presently do. This fine game animal is seldom hunted for itself alone; it is usually taken as an incidental species by sportsmen in pursuit of chukar. Accordingly, the harvest rate for cottontail is directly proportional to the population levels and correlated hunting pressure on chukar.

PROGRAMS OTHER THAN PROJECT-TYPE DEVELOPMENTS AVAILABLE FOR THE IMPROVEMENT OF WATER AND RELATED LAND RESOURCES

Lands in the sub-basin can be treated or can receive aid for treatment under existing U.S. Department of Agriculture and other Federal and State programs. The Bureau of Land Management is responsible for range, recreation, and watershed developments on the Federal land it administers. The owners of private land can receive aid for water and related land resources development by means of various programs under the U.S. Department of Agriculture.

Technical Assistance and Cost-Sharing Under Public Law 46

Under the provisions of Public Law 46 the Soil Conservation Service furnishes technical assistance through Soil Conservation Districts, and the Agricultural Conservation Program of the Agricultural Stabilization Conservation Service provides cost-sharing. Under these programs, assistance in developing coordinated conservation plans and in applying conservation measures may be furnished for farms and ranches. These plans provide for surveys, land use adjustments, erosion control, water conservation, irrigation, drainage, flood prevention, and recreation development. Solution to the sub-basin problems on private land may be arrived at in part by these programs.

The Soil Conservation Service has the responsibility for leadership in the National Cooperative Soil Survey. With the assistance of several cooperative groups and agencies in this work, soils maps and survey reports will be published in the regular schedule of soil survey publications of the U.S. Department of Agriculture.

Agricultural Water Management

There are many ways of improving water management on individual ranches throughout the sub-basin. Some of the treatments for various types of problems are listed below.

Problems	Suggested treatment
1. Variable or limited water supply.	a. Design ranch or farm operation to best take advantage of water available for irrigation needs for 80 percent occurrence or better. b. Level land for even water application. c. Investigate the possibility of using basin irrigation in the Lovelock Valley, to improve water use efficiency and promote better leaching. d. Plant the fields having the best soils with the highest yielding crops which are suited to the farm operation.

Problems	Suggested treatment
1. (Continued)	e. Plan the use of the available water - first to the highest yielding crops (usually perennials) - and second to other crops (usually annuals). f. Consolidate closely paralleling ditches. g. Install irrigation water control structures. h. Irrigate each field only to the extent necessary to fill the root zone of the soil to field capacity. i. Control phreatophytic plant growth. j. Line or seal ditches through reaches with excessive seepage loss. k. Develop supplemental irrigation water from wells or by drainage where investigation reveals their feasibility. l. Keep ditches clean. m. Establish a fertilization program.
2. Saline soils.	a. Install drains, to lower water table. b. Use the best quality water available suitable for crop use, to reduce salt concentration in the soil. c. Use proper soil and water management practices.
3. High water table.	a. Install adequate and suitable drainage. b. Land smoothing to remove low ponding areas. c. Line and seal ditches. d. Irrigate only to the extent necessary to fill the root zone of the soil to field capacity, or for satisfactory leaching. e. Irrigate only when soil profile becomes dry or the plants show early signs of wilting.
4. Low-efficiency use of water.	a. Level or smooth land for even water application. b. Reorganize water distribution and irrigation systems. c. Line ditches through highly permeable soils. d. Irrigate only when soil profile becomes dry or the plants show signs of wilting. e. Irrigate only to the extent necessary to fill the root zone of the soil to field capacity. f. Plant high-yielding crops suitable for conditions, to reduce irrigated acreage now needed for hay production.

Problems	Suggested treatment
5. Inadequate water distribution systems on farms.	a. Reorganize water distribution systems. b. Use lined ditches or pipe lines through highly permeable soils. c. Construct necessary control structures in ditches.
6. Wind erosion.	a. Crop residue management. b. Cultural treatment.

Vegetal Improvement

Widespread sheet erosion and severe streambank cutting and channel erosion, particularly in the mountainous areas, indicate the need for action to reverse the trend toward land deterioration. Each of the following solutions would contribute in some measure to the improvement of plant species and cover, which in turn will help reduce this erosion.

Problems	Suggested treatment
Irrigated lands	
1. Low yields.	a. Establish higher-yielding forage crops suitable to the soil and water conditions, for hay and pasture. b. Replant or rotate perennials when yield decreases, usually every five to eight years. c. Use irrigation methods that will permit more efficient use of water and create an environment for higher-producing crops. d. Use proper soil and water management practices and adapted vegetal species, particularly on saline-alkali soils. e. Develop a fertilization program. f. Do not feed on wet fields.
Nonirrigated lands	
1. Range condition static or on decline.	a. Develop a program of seeding and rehabilitation of suitable rangelands, or as replacement areas for seriously depleted critical watersheds unsuitable for grazing. b. Practice rotation-deferred grazing. c. Use bottomland pasture to supplement available range. d. Control low economic value plant growth along the bottomlands, to increase forage production. e. Control noxious and poisonous plant growth, for range betterment. f. Establish proper use practices. g. Fence, to enable better grazing control and proper range use. h. Improve salting and water distribution for better grazing control.

Watershed Protection and Erosion Control

Except for the relatively small areas which are inaccessible, poorly watered, or fenced, the range is in poor condition. The treatments required to reverse the condition trend would include range seeding and spraying of sagebrush on very limited sites, along with good range management, including proper use and deferred-rotation grazing.

Channel and gully erosion are very active throughout the sub-basin. Permanent type control structures and land treatment measures are needed to protect the stream channels. In addition, such practices as bank sloping, seeding of banks, and channel fencing along selected areas will help heal the erosion and meadow desiccation so prevalent along stream bottoms.

The poor condition of the range suitable for grazing in the mountainous areas, particularly in the Humboldt Range and Eugene Mountains, and the great lack of suitable range in the Trinity Range and the southern portion of the West Humboldt Range, make wise, selective, high-quality range management a necessity in this sub-basin. To assure some semblance of range and watershed restoration in these mountain areas, rest-rotation grazing, long-term deferral, or complete elimination of grazing use is necessary on many areas now being grazed.

Possibilities for Water Salvage

Ground water use by all phreatophytic plants is estimated to be about 54,000 acre-feet annually (see table 3). This includes 18,900 acre-feet used by alfalfa, four-wing saltbush, and the wet meadow grass species harvested as hay or pasture.

Phreatophytic plants of low economic value use about 35,100 acre-feet. More effort should be made to control or replace these water-consuming plants by spraying, deep drainage and blading. This is especially true in the area above Rye Patch Dam, where as much as 10,000 acre-feet of water may be salvaged.

Below Rye Patch Dam, the bulk of the phreatophytes are found south of the croplands in lower Lovelock Valley. It is doubtful whether salvage of water by phreatophyte control here would be beneficial, because of poor quality water and saline soils.

Bureau of Land Management Programs

Public Domain

The Bureau of Land Management is responsible for the administration and management of approximately 50 percent of the acreage in the Lovelock Sub-Basin. Highlights of the Bureau's range management program include the proper use and improvement of the public domain. In addition, the Bureau is responsible for fire presuppression and control activities on the intermingled public and private lands it administers.

Adjudication of grazing priviliges in this sub-basin has only begun. After the adjudications are completed and the allotments are fenced, management plans will be developed for each allotment, to insure proper use of the forage resources.

The soil and moisture program is integrated with the grazing program, and consists of stabilization and rehabilitation projects necessary to conserve soil, water, and closely related resources. The work also includes improvement of vegetation through natural revegetation, control of undesirable forage plants, seeding of more desirable plants, as well

as soil surveys and hydrological studies on pilot watershed areas. The weed control program is designed to arrest the invasion and spreading of weed species which are poisonous or mechanically injurious to domestic livestock, or which threaten the agricultural economy of the area. Another facet of range and watershed management requiring immediate attention is the erosion-proofing or revegetation and retirement of old, abandoned, or low-standard roads, the contributory source of a considerable amount of washing, gullying and sedimentation. It is planned that the construction of all new roads will be done to proper standards and with adequate drainage.

Land classification, fire protection, and recreation are important phases of the Bureau of Land Management program. The long range land program includes the encouragement of land exchanges, in order to establish a more desirable land pattern, particularly on the higher watershed lands. The Bureau's proposed recreation development program is briefly outlined in table 4.

The public domain in the Lovelock Sub-Basin, along with intermingled private lands, provides only a limited amount of summer and winter range for deer.

Fire Protection

Bureau of Land Management

The Winnemucca District of the Bureau of Land Management provides fire protection on the public domain lands, and also presently on the intermingled private lands, in order to fully protect the Federal lands. The following factors have helped or are needed to keep abreast of the increasing fire risks and hazards:

1. The introduction of new techniques, including more widespread and agressive fire protection, and improved fire prevention and patrol measures, commemsurate with the increased public use.

2. More and better suppression equipment. Three fire control agencies concerned have established air tanker bases at Elko and Minden, to be used for the suppression of wild fires.

3. The recognition of high hazard areas from the study of past fire occurrence maps and fuel type maps, as well as keeping posted on new cheatgrass area buildups. Where possible, convert from high hazard species to lower fire danger cover (see photograph 37).

4. Intensified and more diligent inspection and hazard elimination along the Southern Pacific and Western Pacific rights-of-way. Insist that railroads adhere closely to the Nevada fire laws with respect to fireproofing of diesel locomotives. Trucking firms, mining operations, and contractors using internal-combustion equipment should also be checked for compliance with this section of the fire laws.

5. Use of improved national fire danger rating systems.

6. Improved fire detection and radio communications.

7. Inclusion of cooperator ranch crews in Federal control organizations.

8. Hazard reduction in connection with road maintenance and recreation site development.

9. Increased cooperation by Humboldt and Pershing Counties with the Nevada Division of Forestry to provide better fire protection on the private lands.

Nevada Division of Forestry

At the present time, the Nevada Division of Forestry does not have a fire control organization in the sub-basin, although it has the responsibility for protecting the private lands from fire. To aid in implementing the discharge of the responsibility for protection of the intermingled private lands, starting in May 1965 the Nevada Division of Forestry began employing a full-time area forester for northern Nevada. This man, stationed at Elko, will work with the County Commissioners of the five northern Nevada counties, including Humboldt and Pershing, to develop local fire control organizations for protection from and control of fires on private lands.

Photograph 37. - This crested wheatgrass trial seeding put in by the Bureau of Land Management on a portion of the 1963 Raspberry Fire is an excellent example of type conversion from a former high fire hazard big sagebrush-cheatgrass cover to relatively fireproof perennial grass. In addition, the area has been made secure from the serious wind erosion which has developed on adjacent unseeded portions of the burn. FIELD PARTY PHOTO 6-867-3

WATERSHEDS WITH OPPORTUNITIES FOR PROJECT-TYPE DEVELOPMENT

The Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, as amended) authorizes the Secretary of Agriculture to give technical and financial help to local organizations in planning and carrying out works of improvement in watershed or sub-watershed areas of 250,000 acres or less. These projects are for: (1) flood prevention; (2) agricultural phases of water management; (3) public recreational developments; and (4) other purposes, such as municipal and industrial water supplies, and improvement for fish and wildlife.

Project works of improvement include land treatment measures and individual structures having not more than 5,000 acre-feet of flood-water detention capacity, or not more than 25,000 acre-feet of capacity for all purposes.

Watershed projects provide a means for accelerating coordinated scheduling and installation of needed improvements on public and private lands.

The problems in the Lovelock Valley Watershed are such that they can best be handled on a project basis. Projects in this watershed would provide for flood control and agricultural water management, with some watershed protection and recreational features.

Lovelock Valley Watershed

The Lovelock Valley Watershed is located in south-central Pershing County, and includes nearly all the bottomland of Lovelock (Big Meadows) Valley. It includes some drainages on the west slopes of the Humboldt Range, east of Rye Patch Dam at Oreana, as well as drainages from the Trinity Range west of Lovelock Valley.

The soils and geology of the watershed area have been markedly influenced by the shorelines and sediments of prehistoric Lake Lahontan. In more recent times, the cropland soils have been developed from the sediments discharged by the Humboldt River at its terminus.

Total area of the watershed is approximately 210,000 acres. About 129,400 acres are privately owned, and the remaining 80,600 acres are public domain. There are an estimated 90 land owners, excluding the ownerships within the city limits of Lovelock. The Southern Pacific Land Company owns approximately 55,310 acres of the private land within the watershed. Approximately 38,400 acres in the watershed have water rights, of which 31,300 acres are presently being irrigated.

The acreage of irrigated crops varies from year to year, depending upon the available water supply. Presently, about 31,300 acres have been developed and are being used to produce a wide variety of crops, principally alfalfa, grain, and irrigated pasture. The acreage of alfalfa makes up about one-half the cropland area.

One-third of the rangeland in the project area consists of shadscale; one-fifth consists of nonbeneficial phreatophytes, which are using an estimated 9,000 acre-feet of water annually. Approximately 15 percent of the range area is composed of big sagebrush-grass, and nearly two percent is black sagebrush. All the rangeland is in the low forage production class.

Precipitation on the Lovelock Valley Watershed varies from an average low of four inches at the Lovelock Airport to an estimated average high of 18 inches on the Humboldt

Range. On the basis of records from several stations, the estimated average growing season for Lovelock Valley is 130 days at 32 degrees F, and 160 days at 28 degrees F.

The estimated uses, losses, and outflow for an 80 percent frequency year for the watershed area is as follows:

	Acre-feet
Irrigated crops (23,200 ac.)	44,400
Phreatophytes (nonbeneficial)	9,000
Phreatophytes (beneficial, range type)	2,000
Municipal water	300
Outflow from watershed area	37,600
Total	93,300

There are four irrigation water wells in the watershed area. Alfalfa is the greatest user of water, with an estimated use of 2.5 acre-feet annually.

The chief problems in the proposed watershed with relation to water and associated land use are:

1. High water table.

2. Management of saline-alkali soils.

3. Lack of adequate water control structures.

4. Loss of water by canal seepage.

5. Closely paralleling laterals and canals.

6. Floodwater and sediment damages to cropland in the northwestern part of the cropland area.

The dry-mantle floods of 1961 and 1963 caused damage to 670 and 530 acres of cropland, respectively. Sediment deposition amounted to 69 percent of the total damage. Another 18 percent was attributed to water damage, and the remaining 13 percent was considered indirect damage.

Preliminary investigations indicate flood damage can be partially controlled by a detention dam in the stream channel contributing the major portion of the damages. This installation should be made in conjunction with a diversion channel and dikes.

A preliminary evaluation of the works of improvement proposed for this watershed is sufficiently favorable to warrant a more detailed study to determine the feasibility of a project watershed.

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APPENDIX I

Pertinent elaborative material of value to the general reader, for his reference and guidance in the use of the sub-basin report.

CONTENTS

INITIATION OF ACTION
for
PROJECT-TYPE DEVELOPMENT

Accomplishing the Improvements, Public Law 566

The development of project operations would need to be initiated by a local sponsoring organization representing the landowners and operators. The sponsoring organization could initiate such action by submitting an application for watershed planning assistance to the Director of the State Department of Conservation and Natural Resources.

Under the provisions of the Watershed Protection Act, and the operations procedures as developed by the U. S. Department of Agriculture, a local sponsoring organization would provide needed land rights for structural improvements, and assume the responsibility for contracting the structural work and for its subsequent operation and maintenance.

The landowners would have responsibility for the installation of land treatment measures on the privately owned lands. Cost-sharing and credit assistance could be made available by the U. S. Department of Agriculture for such work.

The Bureau of Land Management would assume responsibility for the installation of land treatment measures on the Federal lands it administers, which would be accomplished with the usual participation in costs by the range users.

Funds appropriated under the Watershed Protection Act can be made available to defray the cost of construction of the structural improvements for flood and sediment damage prevention, and to share in the cost of structural improvements for irrigation and recreation storage.

LOVELOCK VALLEY WATERSHED

Physical Features of the Watershed

Location

The Lovelock Valley Watershed is located in south-central Pershing County, in northwestern Nevada. It includes all the Lovelock Valley lying west of the Humboldt River north of the Pershing-Churchill County line, and east of the Pershing County Water Conservation District boundary south of Perth. In addition, it includes watershed lands on the east slope of the Trinity Range, from the Trinity Canyon drainage south to the drainage divide that extends to U.S. Highway 40 at Perth. It also includes the watershed lands on the west slope of the Humboldt Range, including the Rochester Canyon drainage and extending northward to O'Neil Canyon drainage, and the reach of the Humboldt River south from Rye Patch Dam to the vicinity of Woolsey.

Geology

Deposits in the valley lowland include beach, deltaic, and other lake-associated sediments, stream and marsh accumulations, and windblown dune sand. Soils developed from flood plain and deltaic alluvium have little or no profile development.

Several surfaces occur, including the river flood plain, lake-associated surfaces, and a complex surface formed by alluvial fans which varies considerably in age and erosional and depositional features. Alluvial fans encroach upon lower surfaces at different localities.

The terraces are shoreline features built by ancient lakes which inundated the area during Quaternary time. They are developed up to a maximum elevation of about 4,380 feet, and consist in large part of shoreline deposits. Alluvial fans are developed on the terraces, and they may consist of alluvium eroded from terrace materials or alluvium derived from both terrace and highland slopes above the terraces. Locally, algal tuffa mounds protrude above the surface of the ground.

Consolidated rocks of Cenozoic age are exposed in highland areas bordering Lovelock Valley. They have been faulted and folded, and include lava flows, tuffs, breccias, limestone, shaly limestone, calcareous shale, dolomite, sandstone, conglomerate, altered volcanic rocks, and metamorphic rocks. These consolidated rocks have been intruded by masses of granodiorite, quartz monzonite, and other igneous rocks exposed at scattered locations. Younger volcanic rocks, including rhyolitic and basaltic lava flows and pryoclastic rocks, overlie older rocks. Some valley fill materials of Tertiary age occur in mountainous areas.

Soils

Soils in the mountainous areas have been developed on sedimentary and volcanic deposits. They vary in depth from shallow to deep, are stony or gravelly medium textured, and are well to excessively drained.

On the upland benches and terraces the soils have developed primarily in alluvium. They are mostly moderately deep to deep, medium to stony or gravelly medium textured, and well drained. The salt and alkali concentrations vary from none to slight. There are some shallow-depth soils that are underlain by a cemented claypan or cemented gravel.

The soils in the floodplains are mostly lake sediments or reworked lake sediments which may be mixed with alluvium or windblown deposits. They are mostly deep, medium to fine textured, imperfect to poorly drained, and have salt and alkali concentrations that vary from slight to strong.

The irrigated soils appear to have been formed under poor drainage conditions. Drainage of these soils, both naturally and artificially, along with limited local applications of soil conditioners and fertilizers, has improved their productivity. It has been suggested that the amount of organic matter present in most of these soils might increase the water holding capacity by 50 percent over normal. For a more detailed description of these soils, see Soils, General Sub-Basin Characteristics, and Soils Tables 7 and 8, Appendix I.

Vegetation

A mixture of shadscale and bud sagebrush, with shadscale the more common, is the predominant vegetal type over much of the proposed watershed above the Humboldt bottomlands. This range site makes up approximately one-third of the total rangeland area. The shadscale-bud sage cover type occupies the alluvial fans, with fingers extending into the big sagebrush-grass on the upland bench and terrace sites above. The upland bench and terrace sites serve as transition zones between the species found on the bottomlands and the alluvial fans and those on the limited low sagebrush-claypan bench sites at the upper reaches of the Trinity Range. There is considerable overlapping and intermixing of cover types between the upland bench and terrace sites and the claypan bench sites.

On the saline bottomland, semi-playa, alkali flat and wet saline bottoms occupying the Humboldt bottomland and floodplain, between Rye Patch Dam and the Humboldt lakes, many phreatophytic shrub species occur, such as black greasewood, rubber rabbitbrush, willow, cottonwood, and tamarisk (salt cedar). Growing as an understory to these shrubs, or as separate cover types in many instances, are found Great Basin wildrye, creeping wildrye, alkali sacaton, saltgrass, seepweed, and pickleweed. Greasewood is a rather minor component of the alkali flat range site surrounding Humboldt Lake and its playa. This species also makes up a minor portion of the cover on the wet saline bottoms fringing the Lovelock cropland.

In the Humboldt and Trinity Ranges, black sagebrush or low sagebrush predominate on the mountain slopes, extending from the upland benches and terraces to the low sagebrush sites on the ridges and mountain tops. Black sagebrush is usually present at the lower elevations of the low sagebrush-claypan bench site, while low sagebrush grows on the rocky, thin-soiled ridges and mountain tops, interspersed with scattered, stunted Utah juniper. Low sagebrush occasionally extends short distances downward into the big sagebrush and sparse juniper in the upland bench and terraces range site.

Principal grass species present as very thin understory to the browse in the upland bench and terraces and the claypan bench sites in the Humboldt and Trinity Ranges are Thurber needlegrass, Sandberg bluegrass, thickspike wheatgrass, and cheatgrass. Forbs generally associated with these grass and browse species are phlox, locoweed, lupine, buckwheat, and annual mustards.

Climate

Average annual precipitation for recording stations in and adjacent to the watershed is as follows:

Station	Elevation	Years of record	Average annual precipitation (inches)	Extrapolated annual precipitation 1/ (inches)
Lovelock FAA AP	3,900	16	4.4	4.0
Lovelock	3,980	70	4.8	---
Rye Patch Dam	4,140	28	7.1	5.5
Imlay	4,200	87	5.7	---
Spaulding Canyon 2/	6,200	4	11.4	---
Limerick Summit 2/	6,100	4	11.4	---

1/ Based on long-term record at Lovelock. 2/ Storage gage.

In addition to the above table there are some old records of precipitation for stations at Brady Hot Springs and at Brown (Toy). Data from the above stations and from the water balance studies indicate the average annual precipitation varies from eight to 18 inches in the Humboldt Range (elevation 5,000 to over 8,000 feet), and from seven to 12 inches in the Trinity Range (elevation 5,000 to over 7,000 feet). On the irrigated land the average annual precipitation is about four to five inches.

There are four temperature recording stations in and adjacent to the watershed. Data from the U.S. Weather Bureau for these stations are as follows:

Station	Average annual temperature		Average annual frost free period		
	Degree F.	Years of record	28° F.	32° F.	Years of record
			(days)	(days)	
Lovelock	51.5	65	167	139	42
Lovelock FAA AP	51.1	13	152	124	13
Rye Patch Dam	50.5	27	142	107	13
Imlay	50.4	77	152	126	40

These data indicate the average annual temperature in Lovelock Valley would be about 51 degrees; the length of growing season is about 160 days (28 degrees F), and 130 days (32 degrees F).

A 24-year record of seasonal evaporation (May through October) at Rye Patch Dam, using a Class A Pan, indicates an average loss of 57 inches. Partial records for the remainder of the year (November through April) at Rye Patch Dam and at Fallon indicate an additional loss of 18 inches, and a total average annual loss of 75 inches. Converting these data to actual conditions, the gross evaporation from Rye Patch Reservoir would be about 55 inches; the net evaporation is approximately 50 inches.

Land Status and Use

The land status and use breakdown for the watershed area is as follows:

Land Status	Acres	Land use: Range land Acres	%	Irrigated Acres	%
Public Domain	80,600	80,600	38	------	--
Private	129,400	91,000	44	38,400	18
Total	210,000	171,600	82	38,400	18

The private land is divided among an estimated 90 owners, excluding the ownership within the city limits of Lovelock. Included in the private land are approximately 55,310 acres owned by Southern Pacific Land Company.

The 38,400 acres of irrigated land shown in the tabulation comprise the acreage with water rights within the watershed. Presently, 31,300 acres have been developed, and are being used to produce a wide variety of crops, principally alfalfa, grain, and irrigated pasture.

Federal and private range lands are used for spring-fall, winter, and summer range for livestock, as a year-long habitat for upland game birds and other wildlife, and as a water production area.

Water Supply and Use

The Rye Patch Reservoir is the primary source of water for the project watershed. Water yield from the mountainous areas within the watershed is insignificant; most of this goes into ground water storage.

Analyses of the water supply and uses for the area south of Rye Patch Reservoir are included in the body of this report under Water Yield and Water Use. Water balance studies made by the Field Party for an 80 percent frequency occurrence indicate that 75,000 acre-feet of water are released from Rye Patch Reservoir for irrigation use. Considering only the Lovelock Valley Watershed area, the reservoir releases plus the gross water yeild of 800 acre-feet and 17,500 acre-reet from ground water storage are used as follows:

	Acre-feet
Irrigated crops (23,200 acres)	44,400
Phreatophytes (27,000 acres)	11,000
Municipal water	300
Outflow from watershed	37,600
Total	93,300

At the present time there are four water wells which are used to irrigate or supplement other water on about 720 acres of cropland. There are also a few low-capacity wells for stockwater and farmstead use, as well as for Lovelock municipal water.

Net irrigation requirements for crops grown in Lovelock Valley, as computed by the Blaney-Criddle Improved Coefficient Method, under proper management and producing maximum yields, are as follows:

Alfalfa	31 inches 1/
Spring grain	18 inches
Winter wheat	23 inches
Corn silage	17 inches
Sugar beets	29 inches
Grass pasture	28 inches

1/ Based on crop use without a water table. This rate of use would be increased in the presence of a water table.

Alfalfa grown in Lovelock Valley acts as a phreatophyte. Data released by the University of Nevada Experiment Station indicate that alfalfa grown on land with a five or six-foot water table would obtain about 50 percent of its water requirement from ground water. Farmers in the valley report they have received yields of one and one-half tons of hay from old stands of alfalfa without irrigation.

Water Needs for Recreation Areas and Special Use Sites

At present there is one developed picnic area on Humboldt Project land, immediately below Rye Patch Dam. The Bureau of Land Management has plans to develop a camp and picnic site at the Young Diversion near Woolsey, covering an estimated four acres. Also, some preliminary survey work for a camp and picnic area on the west side of the Humboldt below Rye Patch Dam has been done by various groups. These recreation areas will require a small amount of water use.

Watershed Problems

Agricultural Water Management

The present irrigation water distribution system consists of five diversion dams and six main canals. The combined length of canals and principal laterals is estimated to be 80 miles. Originally the diversion and canal systems were laid out to function independently; consequently, the canals and laterals are often closely parallel (see photograph 38).

Photograph 38. - A striking example of independently developed, unintegrated irrigation systems in the Lovelock Valley, here built closely parallel. On the left, the Young Canal; on the right, the Old Channel Canal from the Pitt diversion. (Looking easterly, toward Coal Canyon in the West Humboldt Range.) FIELD PARTY PHOTO

Other agricultural water management problems which were found to be prevalent include:

1. High water table in some areas.

2. Management of saline-alkali soils.

3. Lack of adequate water control and water-measuring structures.

4. Surface water loss by seepage from canals.

5. Closely paralleling laterals and canals.

6. Need for additional land treatment measures, such as land leveling, improved water management, crop rotation, and the planting of improved pasture.

Floodwater and Sediment Damage

Floodwater and sediment damage is limited primarily to about 800 acres of cropland in the northwestern portion of Lovelock Valley. Among the more serious dry-mantle floods, the high waters of 1961 and 1963 caused damage to about 670 and 530 acres, respectively. In each of these most recent storms, damage was caused by excess water and sediment deposition. This sediment deposition amounted to about 69 percent of the total damage. The sediment choked drainage and irrigation ditches, as well as rendering cropland unproductive. It was necessary to either clean off or relevel the damaged fields and clean out the ditches. Water damage, estimated to be about 18 percent of the total, resulted from drowning of crops, flooding of farm buildings, and washing out of irrigation ditches, roads, culverts, bridges, and telephone cables. The remaining 13 percent was considered indirect damage. This accounted for costs attributed to such things as breakdown in communication, restricted access to farms, and inability to work the fields.

Other Problems

These problems concern the need for: (1) domestic water in upper Lovelock Valley, and an additional water supply for the City of Lovelock; and (2) investigation into the need for rehabilitation of the existing levees and river outlet facilities in the lower Lovelock Valley.

Vegetation - Kind and Condition

Phreatophytes

The bottomlands of the Humboldt River north of Lovelock Valley are covered with such nonbeneficial phreatophytes as black greasewood, rubber rabbitbrush, saltgrass, and wiregrass (Juncus spp.). Phreatophytes of economic value here are alkali sacaton, Great Basin wildrye, creeping wildrye, and fourwing saltbush. Big sagebrush is also found throughout the Humboldt River bottomlands. From its extreme size, coupled with its location near or adjacent to the Humboldt channel, it is believed that it is probably phreatophytic on such sites.

In the Lovelock Valley, phreatophytic greasewood and salt cedar (smallflower tamarisk), with a scattering of rubber rabbitbrush, fourwing saltbush, and silver buffalo-

berry, comprise the principal overstory species in the alkali flats and saline wet meadow sites fringing the irrigated lands. Greasewood, with scattered salt cedar, also forms overstories on the alkali flats and saline wet meadow sites between the cultivated lands and the south extremity of the project area. Saltgrass forms the principal understory to the greasewood or salt cedar, in varying degrees of ground cover density.

Various species of cottonwood, poplar, and elm, as well as Russian olive, occur along the roadsides, ditches, and around farmsteads in Lovelock Valley. These tree species are all phreatophytic, and have all been introduced into the area. They are using approximately five acre-feet of water per acre annually. Total acreage of trees in the valley is estimated to be approximately 100 acres, and their total use of water would be 500 acre-feet, which is negligible compared to other uses. Use of water by these trees is considered to be beneficial, because of their aesthetic value, their protection of cropland areas from desiccating winds, and the shade and cover they provide for songbirds, upland game birds, and other wildlife.

The range type phreatophytes in the proposed watershed, admixed with other species, occupy about 45,700 acres, and use an estimated 11,000 acre-feet of water annually. Reduced to natural stand density and 100 percent composition of phreatophytes, the acreage would be about 27,000. Approximately 85 percent of these phreatophytes are nonbeneficial, and it is estimated that 9,000 acre-feet of water might be salvaged by the control of these stands. However, it is doubtful whether much of this salvaged water, because of its high salinity, would be of value, unless converted to use by highly salt-tolerant plant species through type conversion (vegetal manipulation) on these areas. (See table 5.)

Range Forage Production

Table 6 presents information on the range forage production acreage, present and potential, for the Lovelock Watershed. All the watershed range land is presently in the low forage production class.

The principal vegetal species here are shadscale, black greasewood, big sagebrush, rubber rabbitbrush, black and bud sagebrush, with a sparse understory in some areas of such grasses as squirreltail, Sandberg bluegrass, Indian ricegrass, desert needlegrass, and cheatgrass. In extensive acreages of the alkali flats, the wet saline and saline bottomlands, and the dry desert uplands range sites there is little or no grass or herbaceous understory present.

Watershed cover on the Trinity and West Humboldt Ranges, never luxuriant, even when in pristine condition, has deteriorated to such an extent during the white man's tenure here that not only most of the larger stream bottoms, but even the shortest and shallowest streamcourses, are actively gullied. This has led to extensive dry-mantle flooding and cropland damage on the west side of Lovelock Valley.

In the West Humboldt Range east of Lovelock Valley every short, steep drainage contributes its load of silt, rocks, and flood debris, after even moderate storms. At the southern extremity of the Humboldt Range, frequent flooding in Limerick and Rochester Canyons, following the first dry-mantle floods there in 1918, has caused heavy loss and destruction to roads, railroads and other improvements (see Flood Damage section of the sub-basin report).

Table 5. -- Phreatophyte acreage and annual ground water use, Lovelock Valley Watershed 1/

	Species	Height class	Density	Acreage cropland	Acreage range types 2/	Annual ground water use 2/ (feet)	(acre-feet)
Nonbeneficial	Cottonwood	15'+	.2	-----	100	5.0	500
	Quailbrush	3'+	.06	-----	200	.5	100
	Black greasewood	3'+	.04-.09	-----	8,400	.3	2,500
	Black greasewood	3'-	.02-.04	-----	3,500	.2	700
	Rubber rabbitbrush	3'+	.05-.09	-----	900	.3	300
	Alkali seepweed	---	.02-.09	-----	3,500	.5	1,700
	Pickleweed	2'+	.02	-----	200	.5	100
	Saltgrass	---	.08-.09	-----	6,200	.5	3,100
	Subtotal				23,000		9,000
Beneficial	Fourwing saltbush	3'+	.05	-----	4,000	.5	2,000
	Alfalfa			15,000		1.0	15,000
	Total			15,000	27,000		26,000

1/ These values when referred to in the text are rounded.
2/ These values are based on natural stand densities and 100 percent composition, for each species, except for the irrigated and wet meadows.

Source: Humboldt River Basin Field Party.

Table 6. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Lovelock Valley Watershed

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
1. Semi-playa-greasewood-pickleweed; alkali bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	-----	-----	0-50	-----	-----	0-50	
A6-R4	-----	-----	2,600	-----	-----	2,600	Proper management and stocking.
Subtotal	-----	-----	2,600	-----	-----	2,600	
2. Salt cedar-greasewood-saltgrass; wet saline bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	-----	-----	25-100	-----	-----	25-100	
H4-H3-A6	-----	-----	1,900	-----	-----	1,900	Proper management and stocking.
Subtotal	-----	-----	1,900	-----	-----	1,900	
3. Salt cedar-greasewood; alkali flats	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	-----	-----	25-100	-----	-----	25-100	
A6-R4	-----	-----	9,200	-----	-----	9,200	Proper management and stocking.
H4-H3-A6	-----	-----	21,000	-----	-----	21,000	
Subtotal	-----	-----	30,200	-----	-----	30,200	
4. Rabbitbrush-greasewood-grass; saline bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	850-1,500	200-900	20-300	850-1,500	200-900	20-300	
H4-H3-A6	-----	-----	6,400	2,000	2,400	2,000	Brush removal by blading, streambank and channel stabilization, proper management and stocking, and cross-fencing.
R13-L10-B1-C2	-----	-----	300	-----	300	-----	
S2-R2-A7	-----	-----	4,000	-----	2,000	2,000	
S16-R9-A7-G1	-----	-----	300	-----	300	-----	
Subtotal	-----	-----	11,000	2,000	5,000	4,000	
5. Shadscale-grass; droughty desert uplands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	100-350	50-150	10-70	100-350	50-150	10-70	
R5-S9-L12	-----	-----	2,500	-----	1,000	1,500	Fencing, stockwater development, streambank and channel stabilization, erosion-proofing of roads, proper management and stocking.
R9-S9-L12	-----	-----	10,400	-----	5,000	5,400	
S2-R2-A7	-----	-----	10,400	-----	5,000	5,400	
S7-D1-A7	-----	-----	3,500	-----	1,000	2,500	
S7-D1-A8	-----	-----	36,600	-----	10,000	26,600	
S7-D1-G1	-----	-----	3,800	-----	1,000	2,800	
S16-R9-A7-G1	-----	-----	2,700	-----	1,000	1,700	
Subtotal	-----	-----	69,900	-----	24,000	45,900	

Continued

Table 6. -- Acreage of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Lovelock Valley Watershed -- Continued

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
6. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	250-600	100-450	20-150	250-600	100-450	20-150	
R5-S9-L12	-----	-----	27,200	5,000	19,200	3,000	Streambank and channel stabilization, erosion-proofing of roads, intensified fire protection, seeding on selected sites, fencing, proper management and stocking, and stockwater developments.
S6-L3-B3	-----	-----	1,300	-----	1,300	-----	
Subtotal	-----	-----	28,500	5,000	20,500	3,000	
7. Low sagebrush-grass; claypan benches	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	200-500	100-250	50-150	200-500	100-250	50-150	
R5-S9-L12	-----	-----	5,500	1,500	2,500	1,500	Fencing, stockwater development, streambank and channel stabilization, erosion-proofing of roads, proper management and stocking.
Subtotal	-----	-----	5,500	1,500	2,500	1,500	
8. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	300-650	150-350	50-200	300-650	150-350	50-150	
R13-L10-B1-C2	-----	-----	14,900	5,000	6,900	3,000	Streambank and channel stabilization, erosion-proofing of roads, intensified fire protection, fencing, stockwater development, proper management and stocking, and seeding on selected sites.
Subtotal	-----	-----	14,900	5,000	6,900	3,000	
9. Browse-aspen-conifer-grass; steep mountain slopes and basins	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	350-800	200-500	75-250	350-800	200-500	75-250	
R13-L10-B1-C2	-----	-----	3,500	2,000	1,000	500	Fencing, stockwater development, streambank and channel stabilization, erosion-proofing of roads, intensified fire protection, and proper management and stocking.
Subtotal	-----	-----	3,500	2,000	1,000	500	
Total	-----	-----	168,000	15,500	59,900	92,600	

1/ These figures indicate total annual forage production (dry weight), and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

Source: Humboldt River Basin Field Party.

Opportunities for Development

Agricultural Water Management

Improvements needed in the irrigation water distribution system were outlined by the Bureau of Reclamation in their Humboldt Project Nevada report of 1952. These improvements include the following:

1. Abandon the Pitt Diversion Dam and construct a new diversion about one mile upstream. The new dam would be constructed of compacted earth fill about 13 feet high and 350 feet long. The spillway would be gate-controlled and have a capacity of 10,000 c.f.s.

2. The Young and Old Channel Canals would be consolidated and about 4.6 miles of their length lined.

3. The Rogers Canal would be enlarged between the Rogers diversion and the present confluence of the Union and Rogers Canals.

4. Construct new drains as needed and rehabilitate some existing drains.

Other improvements needed include the construction of water control and water measuring structures on the farms. This work would be planned in conjunction with an investigation and possible redesigning of irrigation systems.

Floodwater and Sediment Control

Preliminary investigations indicate that flood damage can be partially eliminated by the construction of a detention dam in conjunction with a diversion channel and some dikes across the unnamed drainage immediately south of Trinity Canyon, in the Trinity Range.

Watershed Protection and Improvement

Improving the rangeland to control erosion and increase forage production would be implemented largely by using better management practices. There are two relatively small areas, however, that may be suitable for seeding. One possible seeding area is on the east slope of the Trinity Range, near the top of the drainage, south of the Seven Troughs road. There are an estimated 2,000 acres at this location with relatively flat slopes, in a six-to eight-inch precipitation zone. The other possible seeding area is at the head of Limerick Canyon. At this location there are about 600 to 800 acres with relatively flat slopes, in a precipitation zone of eight to 10 inches.

The following additional measures should be considered in any program undertaken to improve watershed conditions and increase forage production:

1. Consolidate the public domain ownership pattern by a comprehensive land acquisition program for the intermingled private lands within the former railroad land grant.

2. Adjust domestic livestock and wildlife numbers to the available feed on range suitable for their use.

3. Install gully control structures and bleeder-type gully plugs at selected sites in the small gullies and erosion rills at the drainage heads in the Trinity Range, and in Rochester and Limerick Canyons.

4. Develop channel and streambank stabilization on approximately 15 miles of poor condition (Class 3) stream channel. (See Channel Condition Classification, Appendix I.) Construct the necessary fencing to protect the works of improvement.

5. Treat all roads, in use or abandoned, to prevent or stop erosion. At least 20 miles of road are in need of treatment on lands within the watershed.

6. Phreatophyte control by suitable methods on all bottomland areas where such treatment is practical or desirable.

7. Fire protection on higher slopes having more inflammable vegetal cover.

Other Opportunities for Development

Further investigation will be required to determine the need for rehabilitation of the existing levees and outlet facilities for the lower Lovelock Valley.

The people in the upper valley are interested in obtaining a suitable domestic water supply. It should be determined in the work plan development stage whether the sponsors wish to include such a plan in this project, or in some other program.

Any possibility for the development of recreation facilities and wildlife enhancement should be fully investigated.

Benefits Expected

Agricultural Water Management

The new diversion dam, consolidation of canals, an improved distribution system, and lining of selected sections of the canals, would save an estimated 8,000 acre-feet of water from seepage loss. This water could be used on presently irrigated cropland, or could be used as a full water supply on about 2,000 acres of newly developed land having water rights under the Humboldt Project.

Improvements suggested for drainage and water control would: (1) help to maintain a uniform and beneficial water table; (2) aid in the managing of problem soils; (3) aid in the managing of irrigation water; (4) increase crop yields; (5) reduce labor required for irrigating fields; and (6) reduce operation and maintenance cost on irrigation systems.

Floodwater and Sediment Control

Flood control features proposed in this project would: (1) reduce operation and maintenance needed on drains and irrigation canals; (2) reduce chances for damage to farm buildings; (3) reduce the frequency and extent of damage to crops and cropland; and (4) reduce the frequency and extent of damage to roads, culverts, bridges, and other facilities.

Watershed Protection and Improvement

Results from suggested improvements on the range area could only be expected over a long period of strict management in this predominantly low-precipitation area. Benefits would be in the form of reduced erosion and increased range forage production.

Conclusions

A preliminary evaluation of the proposed works of improvement is sufficiently favorable to warrant a more detailed study, to determine the feasibility of a watershed project. At this writing an application for assistance in the development of a plan for an agricultural water management and flood prevention project has been submitted by the local people to the Secretary of Agriculture. Planning assistance for the development of such a plan has been authorized.

SOILS DESCRIPTION

The generalized soil survey of the Lovelock Sub-Basin shows the location and distribution of different kinds of soils by associations of Great Soil Groups. Each Great Soil Group includes a number of soils with similar internal development. Great Soil Groups mapped in the survey include:

Alluvial Soils (Symbol: A)

These are the soils that consist of essentially recent stream-laid deposits: alluvial fans, floodplains, terraces and basins. They have essentially no profile development, but a little organic matter may have accumulated. They are usually deep, stratified, variable with regard to drainage class, and occur under many different climates.

Brown Soils (Symbol: B)

These are the soils which have dark brownish A horizons about six inches thick, textural B horizons 10 to 15 inches thick, and calcareous parent material of variable thickness. Some of these soils have cemented calcium carbonate layers in the C horizon, and some may have the C horizon resting on bedrock. They are usually moderately deep to deep, well drained, and occur under a cool semi-arid climate with an average precipitation of six to 20 inches. Most of the Brown Soils in the Lovelock Sub-Basin occur at elevations above 4,500 feet, in the uplands.

Chestnut Soils (Symbol: C)

These soils have dark grayish brown to very dark grayish brown A horizons about six to eight inches thick, textural B horizons 10 to 15 inches thick, and parent material that may or may not be calcareous. These soils usually have darker A horizons, more organic matter, and have been more strongly leached than have the Brown Soils. The parent material may or may not rest on bedrock. They are usually moderately deep to deep, well drained, and occur in a cool semi-arid climate with an average precipitation of about eight to 20 inches. Most of the Chestnut Soils in the Lovelock Sub-Basin occur at elevations above 5,000 feet, in the uplands.

Calcisols (Symbol: G)

These soils occur on highly calcareous parent material in the arid and semi-arid regions. They have developed where leaching is limited, but have formed under good to excessive drainage conditions. They include soils in which the calcium carbonate has accumulated to form a prominent Cca on Dca horizon near the lower depth of wetting. They have a light gray-brown A or A1 horizon, about 10 to 15 inches thick, which becomes lighter colored with depth. They are moderately deep, well drained, and occur with an average annual precipitation of about four to eight inches at elevations below 7,000 feet.

Desert Soils (Symbol: D)

These are well to imperfectly drained soils in a cool arid climate. They have a thin light-colored A horizon (less than six inches) that is neutral to mildly alkaline, low in organic matter, with platy structure and frequently vesicular porosity. The B horizon (six to 14 inches) usually contains more clay, and is as dark or darker than the A, is neutral to strongly alkaline, and may be calcareous. A layer of calcium carbonate accumulation, that may be cemented, occurs in or below the B horizon at a depth of one to three feet. They are moderately deep, medium and gravelly medium textured and occur in a four to eight inch precipitation zone.

Humic Gley Soils (Symbol: H)

These are the dark brown or black meadow soils that grade into lighter colored or rust-mottled grayish soil at depths of one to two feet. They are imperfectly to poorly drained, usually with seasonal fluctuating high water table, and occur along stream floodplains where they are subject to overflow. They occur in a cool arid climate, and are found in the Lovelock Sub-Basin at elevations mostly below 5,000 feet.

Lithosols (Symbol: L)

These soils have an incomplete profile, or no clearly expressed morphology. They are shallow (less than 10 to 15 inches), and consist of freshly and imperfectly weathered masses of hard rock or hard rock fragments, and are largely confined to steeply sloping lands. In the higher rainfall areas of the sub-basin, some of these soils may have dark A horizons. They are usually excessively drained.

Regosols (Symbol: R)

These are soils which consist of deep unconsolidated deposits, in which few or no clearly expressed soil characteristics have developed. They are largely confined to colluvial accumulations on steep mountain slopes. Under four to 10 inches of rainfall the Regosols may have only a weakly developed A horizon, while in higher rainfall areas they may have well developed dark A horizons six to 14 inches or more thick. In mountainous areas these soils may be underlain by bedrock 15 to 20 inches below the soil surface.

Sierozems (Symbol: S)

These are soils with a pale grayish or light brownish surface and textural B horizons closely related in color to the surface soil. They are usually calcareous in the B horizon, and frequently also in the surface soil. They quite often have a cemented calcium carbonate hardpan at shallow to moderate depths below the B horizon. The B horizon in the Sierozem Soils in this sub-basin is usually weakly developed and difficult to identify. In mountainous areas the Sierozems may be underlain by bedrock at moderate

depths. These soils are found in semi-arid cool climate, with an average annual precipitation of about four to 10 inches, and mostly at elevations below 6,000 feet.

Solonetz (Symbol: Y)

These are imperfectly drained soils with a very few inches of light grayish or brownish surface soil underlain by a hard columnar fine-textured horizon that is high in exchangeable sodium. They occur on floodplains, terraces, and some alluvial fans, usually as small areas associated with saline-alkali Alluvial Soils, Humic Gley Soils, and Calcium Carbonate Solonchaks.

Mapping Units

Mapping units on the generalized soil survey map of the Lovelock Sub-Basin are associations of phases of Great Soil Groups that reflect characteristics of soils significant to use and management. Each mapping unit symbol includes the designation of approximate composition for each Great Soil Group that comprises the association.

Example: $\frac{\text{L1-C1-R1}}{\text{60-20-20}}$

SOILS TABLES

The following tables, 7 and 8, show the general soil characteristics and the interpretations for each Great Soil Group phase which was mapped in the sub-basin.

Table 7. -- Soil characteristics, Lovelock Sub-Basin

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope range %	Erosion	Salt & alkali	Drainage	Remarks
A2	Deep	Medium and gravelly medium	Medium	2-15	Slight 10% mod.	None	Well	25% stony soils, seedable
A4	Deep	Medium	Medium	0-2	Slight	Slight	Imperfect	Overflowed
A6	Deep	Medium to moderately fine	Medium to moderately fine	0-2	Slight	Moderate to strong	Imperfect to poor	
A7	Shallow to moderately deep	Medium to gravelly medium	Gravelly medium and medium	0-4	Slight 5% mod.	None	Somewhat excessive	Small areas suited for seeding
A8	Deep	Medium	Medium	2-8	Slight 10% mod.	None	Moderately well	20% stony soils
A9	Deep	Medium to moderately coarse	Medium to moderately coarse	0-25	Slight	Slight to moderate	Moderately well	Water table 8-20 feet, overblown with fine sand
A10	Deep	Medium	Medium	2-4	Slight 5% mod.	None	Well	
B1	Moderately deep to deep	Medium	Medium and moderately fine	30-50	Slight 15% mod.	None	Well	Hill creep
B3	Moderately deep to deep	Medium, stony medium, very stony medium	Medium, moderately fine and fine	4-30	Slight 10% mod.	None	Well	25-30% stony soils, 10% deep
B4	Deep	Stony medium and moderately fine	Moderately fine and fine	20-40	Slight 10% mod.	None	Well	5% Chestnut 5% Sierozem
B10	Moderately deep	Medium stony	Fine over hardpan	10-30	Slight 5% mod.	None	Well	
C2	Moderately deep to deep	Medium	Medium to moderately fine	4-15	Slight 10% mod.	None	Well	15-20% stony soils
D1	Moderately deep	Medium and gravelly medium	Medium and gravelly medium	0-4	Slight	None	Well	
G1	Moderately deep over alkali soluble hardpan	Medium and gravelly medium	Medium and gravelly medium	3-10	Slight 20% mod. 10% sev.	None	Well	10% stony soils 40% seedable

Continued

Table 7. -- Soil characteristics, Lovelock Sub-Basin -- Continued

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope range %	Erosion	Salt & alkali	Drainage	Remarks
H3	Deep	Medium and fine	Medium to moderately fine	0-2	Slight	Slight	Poor	Overflowed
H4	Deep	Medium	Medium to moderately fine	0-2	Slight	None	Poor	Overflowed
H6	Deep	Medium and moderately fine	Medium and moderately fine	0-2	Slight	Slight to moderate	Imperfect to poor	Overflowed
L3	Shallow over bedrock	Stony and gravelly medium		20-30	Slight 10% mod.	None	Excessive	10% rockland
LT0	Shallow over bedrock	Stony and rocky medium		30-60	Moderate 10% sev.	None	Excessive	10% rock outcrop
LT2	Shallow over bedrock	Stony medium		16-30	Slight 5% mod.	None	Somewhat excessive	10% rock outcrop
R2	Moderately deep to deep	Coarse	Coarse	4-30	Moderate	None	Excessive	10% active duneland
R4	Moderately deep to deep	Coarse	Coarse	2-7	Moderate wind	None	Excessive	5% active duneland
R5	Moderately deep to deep	Stony and gravelly medium	Medium	30-50	Slight 15% mod.	None	Excessive	
R6	Moderately deep to deep	Stony and gravelly medium	Medium	15-30	Slight 50% mod.	None	Well	
R9	Moderately deep to deep	Stony and gravelly medium	Medium	8-15	Slight 10% mod.	None	Well	5% rock outcrop
RT3	Moderately deep over bedrock	Stony medium	Stony medium	30-60	Moderate 10% sev.	None	Somewhat excessive	10% rockland
S2	Shallow to moderately deep	Medium and gravelly medium	Medium	2-8	Slight 20% mod.	None	Well	
S6	Shallow to moderately deep	Medium	Medium	8-15	Moderate gullying	Slight	Well	15% stony soils

Continued

Table 7. -- Soil characteristics, Lovelock Sub-Basin -- Continued

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope range %	Erosion	Salt & alkali	Drainage	Remarks
S7	Moderately deep to deep	Medium and moderately coarse	Medium and moderately coarse	2-8	Slight 15% mod.	None	Well	15% stony soils
S9	Moderately deep	Medium	Medium	10-30	Slight	None	Well	10% moderately deep gravelly medium Sierozem, 10% deep Sierozem
S12	Moderately deep over hardpan	Medium and moderately coarse	Moderately fine	10-30	Moderate	None	Well	50% seedable
S16	Deep	Medium	Medium	3-10	Moderate 10% sev.	Slight	Well	
Y2	Deep	Medium and moderately fine	Moderately fine and fine	0-3	None	Strong alkali in subsoil	Moderately well	10% saline-alkali soils

Source: Humboldt River Basin Field Party.

Table 8. -- Interpreted soil characteristics, Lovelock Sub-Basin

Soil Phase	Precip. zone (inches)	Erosion hazard	AWHC 1/ (inches)	Soil Hydro-logic Group	Capa-bility subclass	Major land use	Dominant vegetation
A2	6-8	Slight	8	B	VIc	Range	Big sage-grass
A4	5-6	Slight	10	B	IV	Range	Greasewood-saltgrass, rabbit-brush-saltgrass
A6	3-6	Slight	12	C	VIIs	Range	Greasewood-saltgrass, rabbit-brush-saltgrass
A7	4-8	Moderate	3	B	VIIs	Range	Big sage-grass
A8	4-10	Moderate	12	B	IIw VIc	Range	Big sage, shadscale-grass
A9	4-6	Slight	8	B	VIIs	Range	Greasewood-rabbitbrush, bud-sage, shadscale, cheatgrass
A10	4-6	Slight to moderate	12	C	VIIc	Range	Winterfat-budsage, Indian rice-grass
B1	6-20	Moderate	4	C	VIIe	Range	Big sage-grass
B3	8-10	Moderate	8	C	VIc VIIc	Range	Big sage-grass
B4	8-10	Slight	8	C	VIIs	Range	Big sage-grass
B10	6-10	Slight	5	D	VIIs	Range	Low sage-grass, big sage-grass
C2	8-20	Moderate	8	C	VIc	Range	Big sage-grass
D1	3-8	Slight	4	D	VII	Range	Shadscale-budsage
G1	4-8	Moderate	5	D	VIc	Range	Big sage-shadscale
H3	3-6	Slight	10	B	IIw	Irrigated crops	Alfalfa-grain
H4	3-6	Slight	10	B	IIw	Irrigated crops	Alfalfa-grain
H6	5-6	Slight	10	B	IVw VIw	Range and meadow	Rabbitbrush-giant wildrye, salt-grass
L3	6-10	Moderate	1.5	D	VIIs	Range	Low sage-grass, shadscale
L10	6-20	Severe	1.5	D	VIIs	Range and watershed	Low sage-grass
L12	3-12	Slight	1.5	D	VIIs	Range and watershed	Big sage-grass, low sage-grass, shadscale
R2	4-8	Moderate	5	A	VIIs	Range	Big sage-grass

Continued

Table 8. -- Interpreted soil characteristics, Lovelock Sub-Basin -- Continued

Soil Phase	Precip. zone (inches)	Erosion hazard	AWHC 1/ (inches)	Soil Hydrologic Group	Capability subclass	Major land use	Dominant vegetation
R4	3-10	Moderate	6	A	VIIs	Range	Rabbitbrush, spiny hopsage-grass
R5	3-12	Moderate	6	C	VIIe	Range	Shadscale-big sage-low sage-grass
R6	6-10	Moderate	4	C	VIIe	Range	Big sage-grass
R9	3-8	Moderate	4	C	VIIe	Range	Shadscale-budsage
R13	6-20	Severe	4	C	VIIe	Range	Big sage-grass, mixed browse
S2	4-10	Slight to moderate	3	D	VIIs	Range	Shadscale-budsage-grass
S6	6-10	Moderate	4	D	VIIs	Range	Shadscale-budsage
S7	4-8	Moderate	5	C	VIc	Range	Shadscale, spiny hopsage
S9	3-12	Slight	6	D	VIc VIIe	Range, 30% seedable	Shadscale-budsage, big sage-grass
S12	6-8	Severe	6	C	VIIe	Range	Big sage-grass
S16	3-8	Moderate	8	C	VIc VIIc	Range	Shadscale-budsage-big sage-grass
Y2	3-6	Moderate	12	D	VIIs	Range	Big sage-grass

1/ Available water holding capacity.

Source: Humboldt River Basin Field Party.

DEFINITIONS

HYDROLOGIC SOIL GROUPS

Watershed soil determinations are used in the preparation of hydrologic soil cover complexes, which in turn are used in estimating direct runoff. Four major soil groups are used. The soils are classified on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling and without the protective effects of vegetation.

Group A - Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively well drained sand or gravel. These soils have a high rate of water transmission and would result in a low runoff potential.

Group B - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine to fine texture and slow infiltration rate. These soils have a slow rate of water transmission.

Group D - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential; (2) soils with a high permanent water table; (3) soils with a claypan or clay layer at or near the surface; and (4) shallow soils having a very slow rate of water transmission.

LAND USE CAPABILITY CLASSES AND SUBCLASSES

The capability classification is a practical grouping of soils. Soils and climate are considered together as they influence use, management, and production on the farm or ranch.

The classification contains two general divisions: (1) land suited for cultivation and other uses; and (2) land limited in use and generally not suited for cultivation. Each of these broad divisions has four classes which are shown by a number. The hazards and limitations in use increase as the class number increases. Class I has few hazards or limitations, or none, whereas Class VIII has a great many.

Capability classes are divided into subclasses. These show the principal kinds of conservation problems involved. The subclasses are "e" for erosion, "w" for wetness, "s" for soil, and "c" for climate.

Capability classes and subclasses, in turn, may be divided into capability units. A capability unit contains soils that are nearly alike in plant growth and in management needs.

Land Suited for Cultivation and Other Uses

Class I	Soils in Class I have few or no limitations or hazards. They may be used safely for cultivated crops, pasture, range, woodland or wildlife.
Class II	Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.
Class III	Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.
Class IV	Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Land Suited for Range and Other Uses

Class V	Soils in Class V have little or no erosion hazard but have other limitations that prevent normal tillage for cultivated crops. They are suited to pasture, woodland, range or wildlife.
Class VI	Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

Class VII Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

Class VIII Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

ANNUAL WATER BALANCE STUDY

Annual water balance, as used in these studies, is the evaluation of a portion of the hydrologic cycle. The cycle starts with incident precipitation on the watershed, and ends with runoff, both surface and subsurface flow, after subtracting water uses and losses.

The annual water balance was calculated to represent average annual conditions and an 80 percent frequency of occurrence (expected to be equaled or exceeded eight out of 10 years). The 80 percent frequency was used because normally such a water supply would be the quantity needed to justify land and irrigation improvements on ranches growing high-yielding forage crops. (See figures 3 and 4, and table 9.)

Values obtained using this procedure are approximations. Accuracy would depend on the reliability of the basic soils, vegetation, and hydrologic data used, and would normally be in the range of 60 to 90 percent.

The available information used for determining precipitation in the watershed areas consisted of seven recording stations and three storage gages (see Precipitation, this report). These data give an indication of the annual precipitation. The precipitation used in the water balance studies was determined as the quantity needed to produce the average occurrence or the 80 percent frequency flow, after subtracting the water uses and losses.

The annual water balance inventories by watersheds were made to find answers to the following questions:

1. What is the gross water yield of the watersheds in the sub-basin? Gross water yield, for the purpose of this study, is the estimated available water, both surface and subsurface, prior to agricultural and phreatophytic use. Generally, this water yield is estimated for a stream or streams at a point above the highest diversion for the main body of irrigated land on a flood plain of a valley.

2. What is the magnitude of water use and loss by each of the major ground cover types?

3. Where are the water-yielding areas in the sub-basin and in each watershed?

4. Can vegetal manipulation be used to increase water supply for beneficial use?

The sub-basin was divided into two watersheds, in order to obtain a more accurate estimate of water yield, water uses and losses. They are:

1. Imlay Watershed, which includes the area between the Rose Creek stream gage and the Imlay gage.

2. Big Meadows Watershed, which includes the area between Rye Patch Dam and the natural barrier below the Humboldt lakes.

80 Percent Frequency Analysis

The results of the annual water balance studies indicate the following:

1. The 80 percent gross yield (surface and subsurface) was estimated to be 4,300 acre-feet; 2,500 acre-feet from the Imlay Watershed, and 1,800 acre-feet from the Big Meadows Watershed.

2. The estimated surface and ground water uses, losses and outflow are as follows:

	Imlay Watershed		Big Meadows Watershed	
	Acres	Water use acre-feet	Acres	Water use acre-feet
Irrigated crops	400	600	23,200	44,400
Phreatophytes	28,000	10,000	58,000	29,000
Surface water evaporation	------	------	------	25,200
Evaporation from Humboldt lakes	------	------	------	3,000
Municipal water	------	------	------	300
Outflow from watershed	------	55,000	------	400
Total		65,600		102,300

3. The area around Star Peak in the Humboldt Range is the major water-yielding area of the sub-basin.

4. Phreatophytes of low economic value, consisting of cottonwood, willow, salt cedar, wild rose, greasewood, rabbitbrush, seepweed, pickleweed, saltgrass, and quailbrush, use an estimated 35,000 acre-feet of water annually. A large part of this water, particularly 8,500 acre-feet used in the Imlay Watershed, could be put to beneficial use by controlling or replacing some of these water-wasting plants

Average Conditions

An attempt to balance inflow records and water content in Rye Patch Reservoir with reservoir release records, assuming normal losses, indicates a number of unaccountable differences. Time would not permit a detailed research of all the records to find ansewers to some of these questions. It was for this reason that no attempt was made to present normal reservoir operation in this report.

The average values used in the flow diagrams, figures 1 and 2, were obtained, as indicated, from the U. S. Geological Survey stream flow records for the period 1949 through 1963. This is the length of record for the Rose Creek gage. The quantity of water released from Gumboot Lake in 1953 and 1958 was subtracted from the published records at Rose Creek and Imlay prior to computing the average. It was known that the releases from Gumboot Lake were not normal, and would therefore distort the averages.

Average releases from Rye Patch Reservoir can be varied by choosing any desired period of record. The years 1951 through 1963 were chosen for the purpose of this report, to indicate present water use in Lovelock Valley, as stated in the context of the report.

Table 9. -- Summary of Water Balance Studies by elevation zones for watersheds in Lovelock Sub-Basin for an 80% frequency

Elevation zone (feet)	Imlay Acres	Imlay Water Yield in./ac.	Imlay Water Yield acre-feet	Big Meadows Acres	Big Meadows in./ac.	Big Meadows acre-feet
9,000-9,800	600	5.00	250	-----	----	---
8,000-9,000	2,000	2.52	420	3,000	2.52	630
7,000-8,000	7,400	1.34	830	4,600	1.22	560
6,000-7,000	40,600	.22	760	22,700	.18	340
5,000-6,000	111,800	.02	220	88,200	.02	190
4,000-5,000	402,600	----	20	241,400	----	80
3,866-4,000	-------	----	---	123,100	----	---
Total	565,000		2,500	483,000		1,800
Gross Water Yield:			2,500			1,800
Inflow: Rose Creek gage			63,100	Rye Patch gage		75,000
Uses and Losses:						
Irrigated crops			(-) 600			(-)44,400
Phreatophytes			(-) 10,000			(-)29,000
Municipal water			------			(-) 300
Evaporation, Humboldt lakes			------			(-)25,200
Evaporation, playa			------			(-) 3,000
Outflow from watershed			55,000			400
Use from ground water storage			------			25,500

Source: Humboldt River Basin Field Party.

FOREST SERVICE REGION FOUR
CHANNEL CONDITION CLASSIFICATION CRITERIA

The following describes a method of classifying the condition of perennial or intermittent stream channels. Channel condition, as used here, is measured by indicators of channel stability. Classification is not based on any one factor; all the criteria must be weighed before a decision is reached.

Class 1 - Good

1. Channel sides well vegetated.
2. No slumping of channel sides.
3. Very little or no cutting or deposition of channel bottom.
4. Aquatic vegetation on channel sides and bottom.
5. Algae on rocks.
6. Very little or no recent cutting or deposition along channel sides.

Class 2 - Fair

1. Channel sides partially vegetated.
2. Slumping of channel sides at constrictions and bends.
3. Some cutting of channel bottom at constrictions, bends and steep grades and deposition in areas where the water velocity is less, e.g. pools.
4. Aquatic vegetation scattered, mostly in areas where stream velocities are low.
5. Algae on rocks in places where the bottom is stable.
6. Some cutting of stream banks at constricted areas or at outside of bends; deposition at the inside of bends and at the confluence with other streams.

Class 3 - Poor

1. Very little vegetation on channel sides.
2. Slumping of channel sides common.
3. Cutting and deposition of channel bottom common, bottom obviously in a state of flux.
4. No aquatic vegetation.
5. No algae on rocks.
6. Large-scale cutting of stream banks common.

Channels in Rock

In some instances, the channel cross section may be carved in rock. In this case, some of the factors listed under the Fair or Poor class may be in evidence, e.g., lack of vegetation on banks and deposition at grade changes. In order to classify the condition of such channels on the basis of channel stability, they must be considered to be in the Good condition class.

APPENDIX II

This appendix is produced in a relatively limited number of copies. It contains material germane to the Lovelock Sub-Basin but which, because of its detailed or technical nature, is not attached to copies for general distribution.

Such material, however, has potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Lovelock Sub-Basin.

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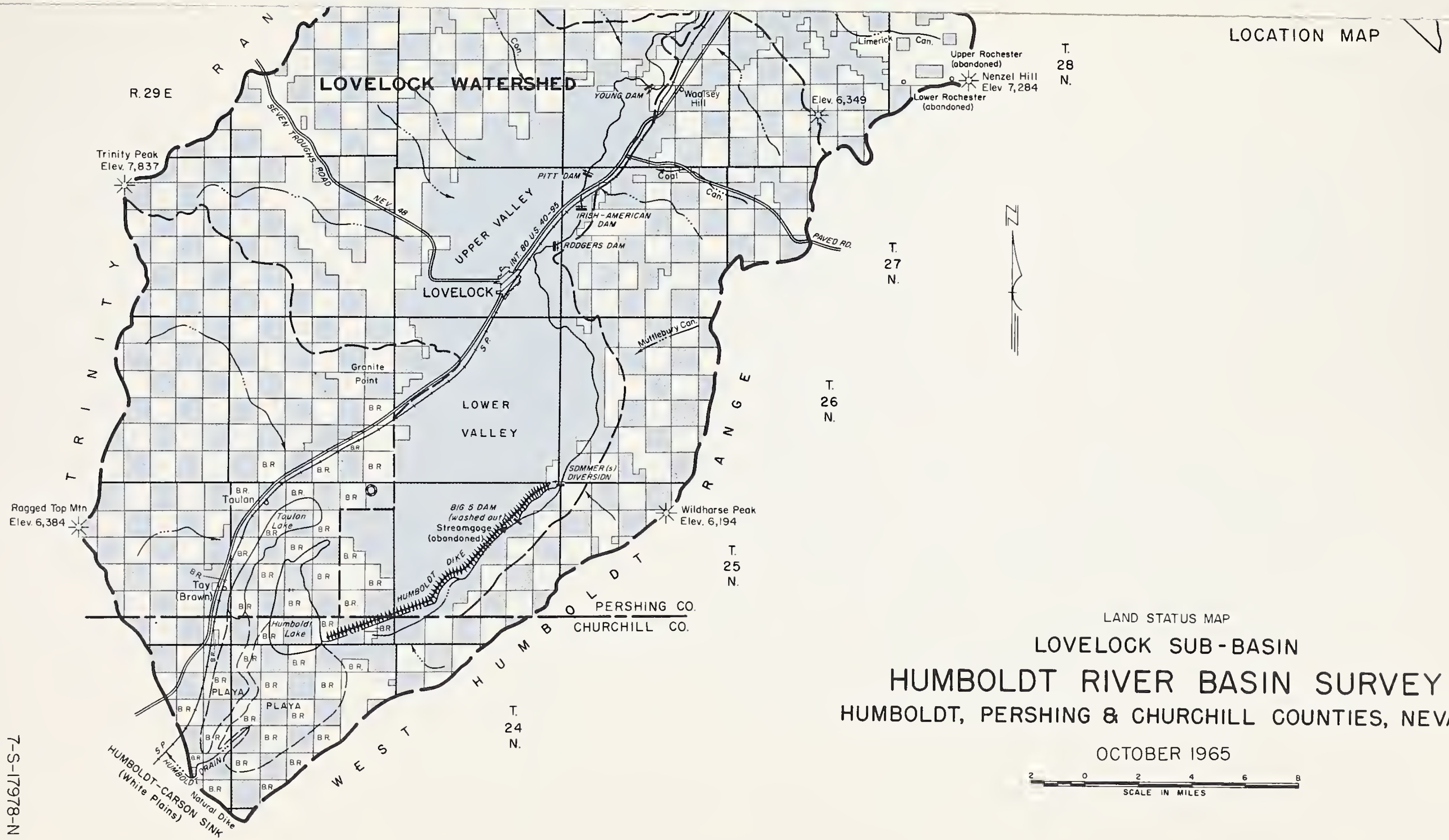

LAND STATUS MAP

LOVELOCK SUB-BASIN

HUMBOLDT RIVER BASIN SURVEY

HUMBOLDT, PERSHING & CHURCHILL COUNTIES, NEVADA

OCTOBER 1965

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SCALE IN MILES

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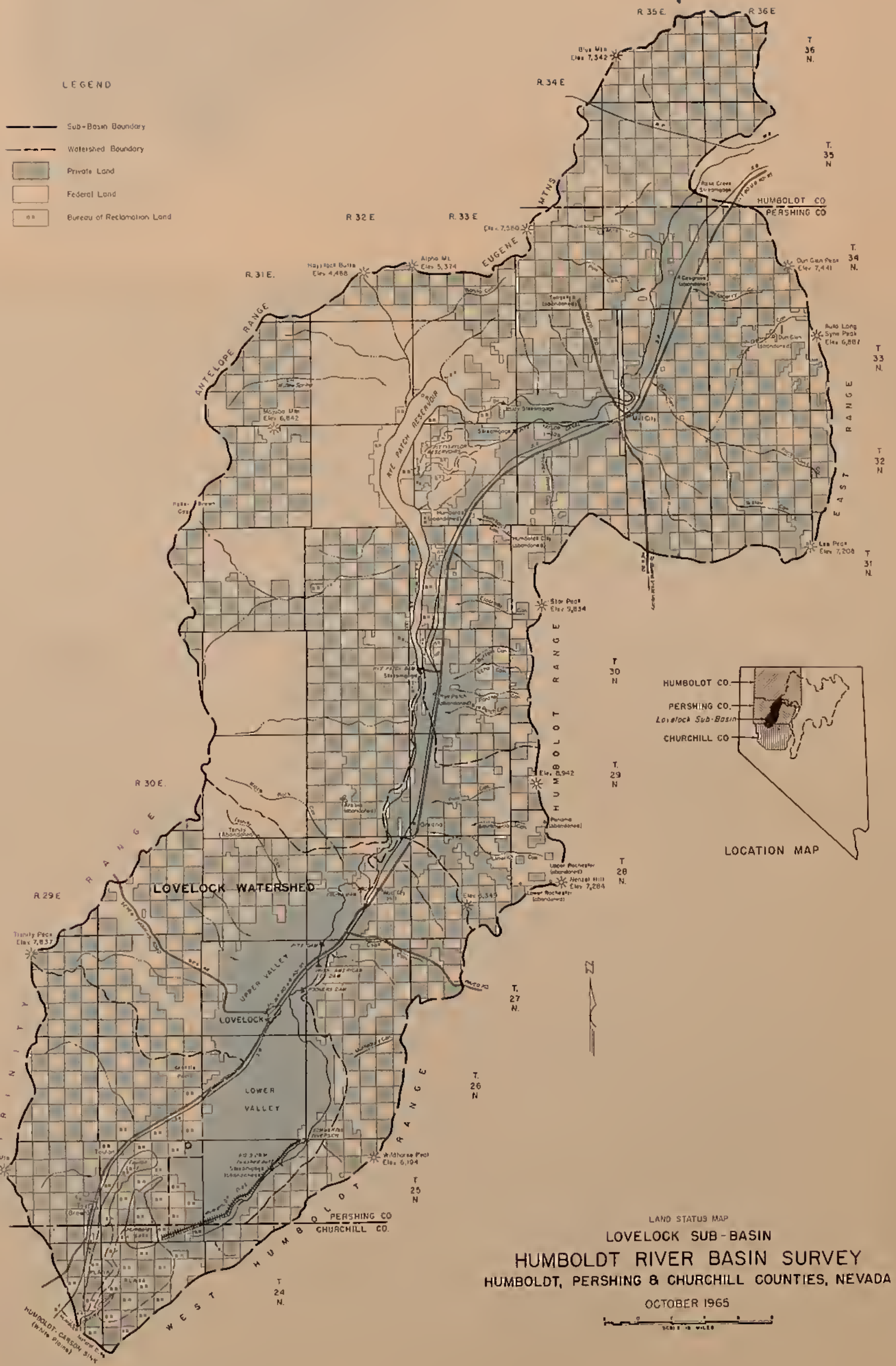

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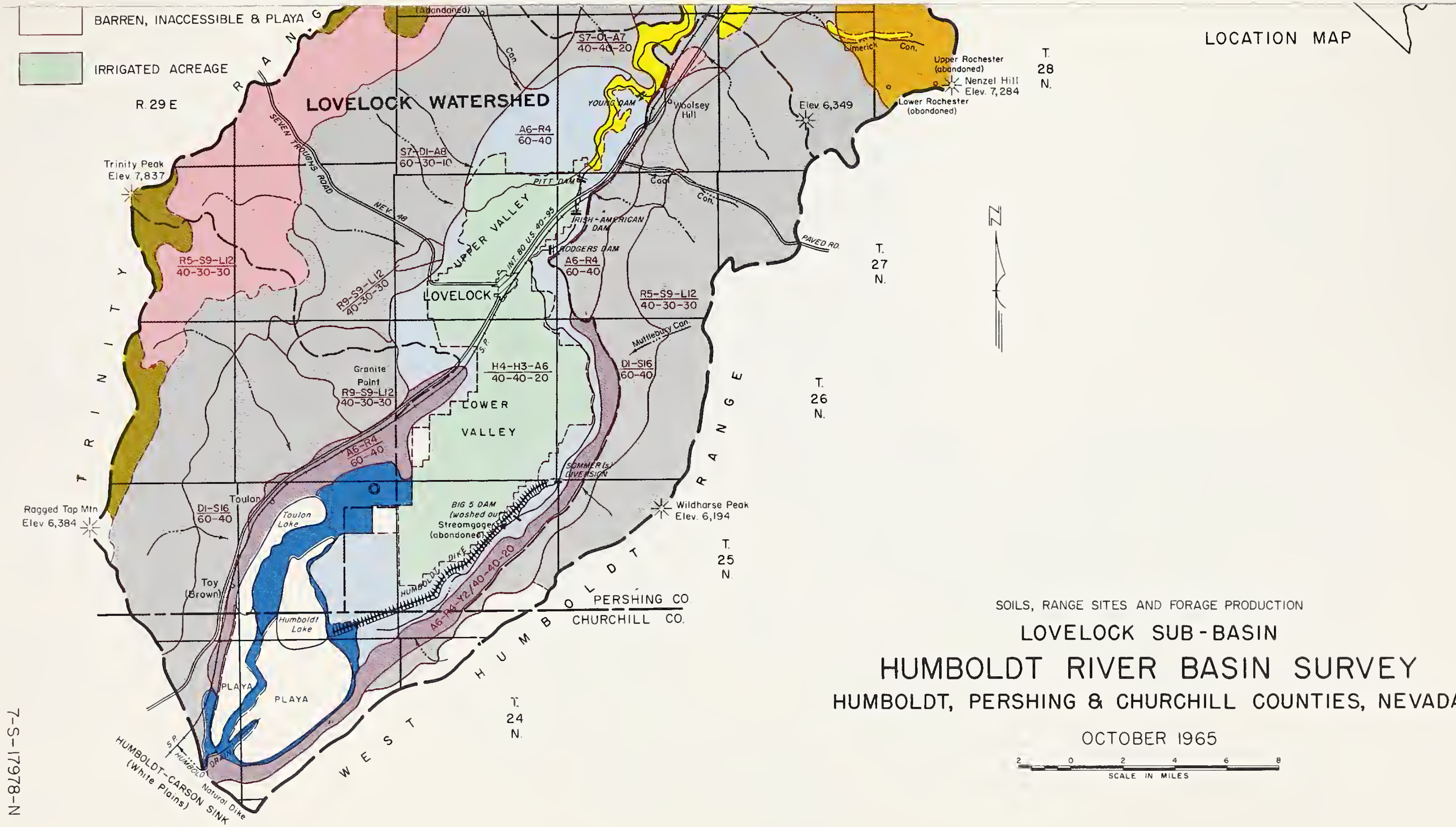

SOILS, RANGE SITES AND FORAGE PRODUCTION

LOVELOCK SUB-BASIN

HUMBOLDT RIVER BASIN SURVEY

HUMBOLDT, PERSHING & CHURCHILL COUNTIES, NEVADA

OCTOBER 1965

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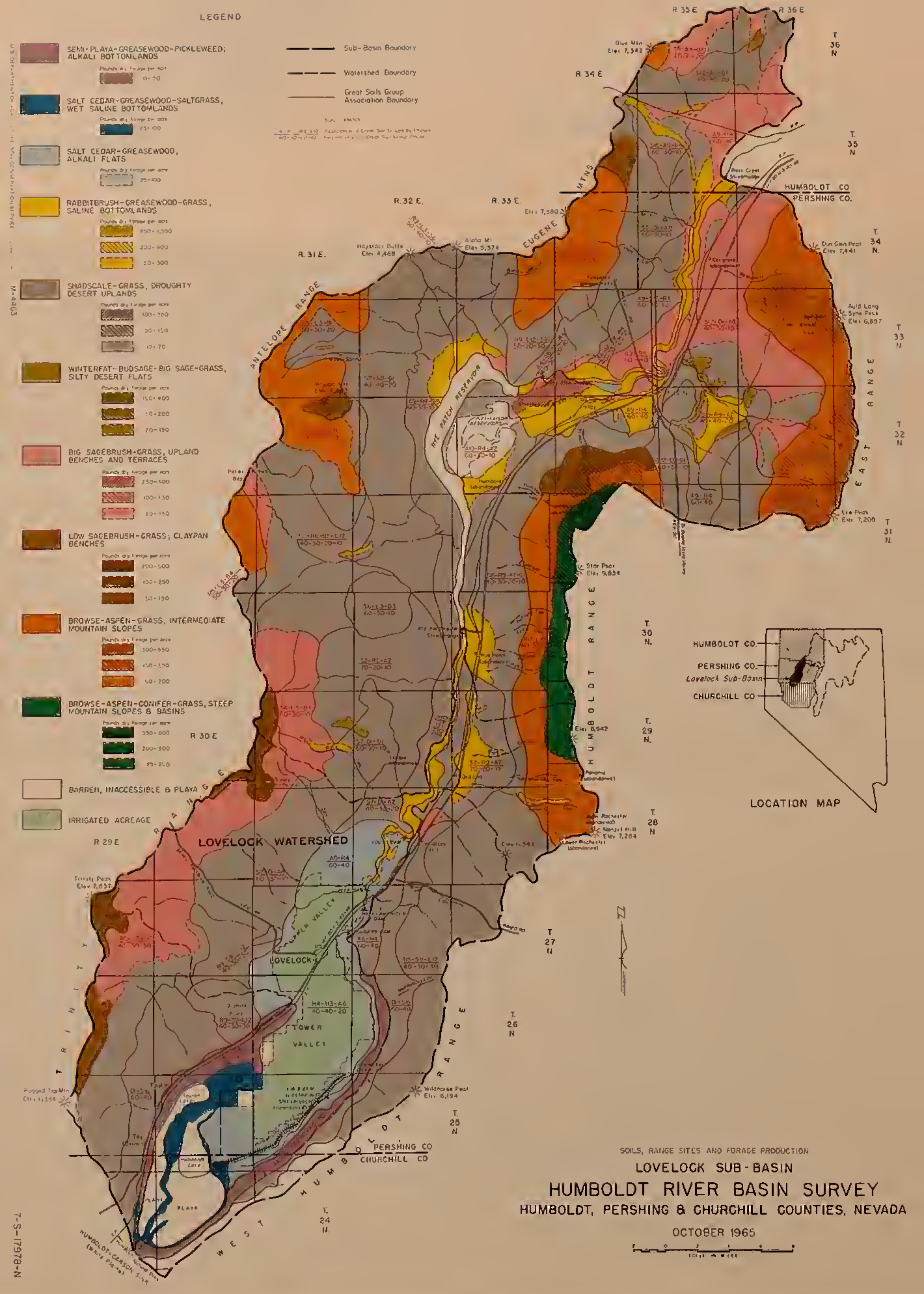


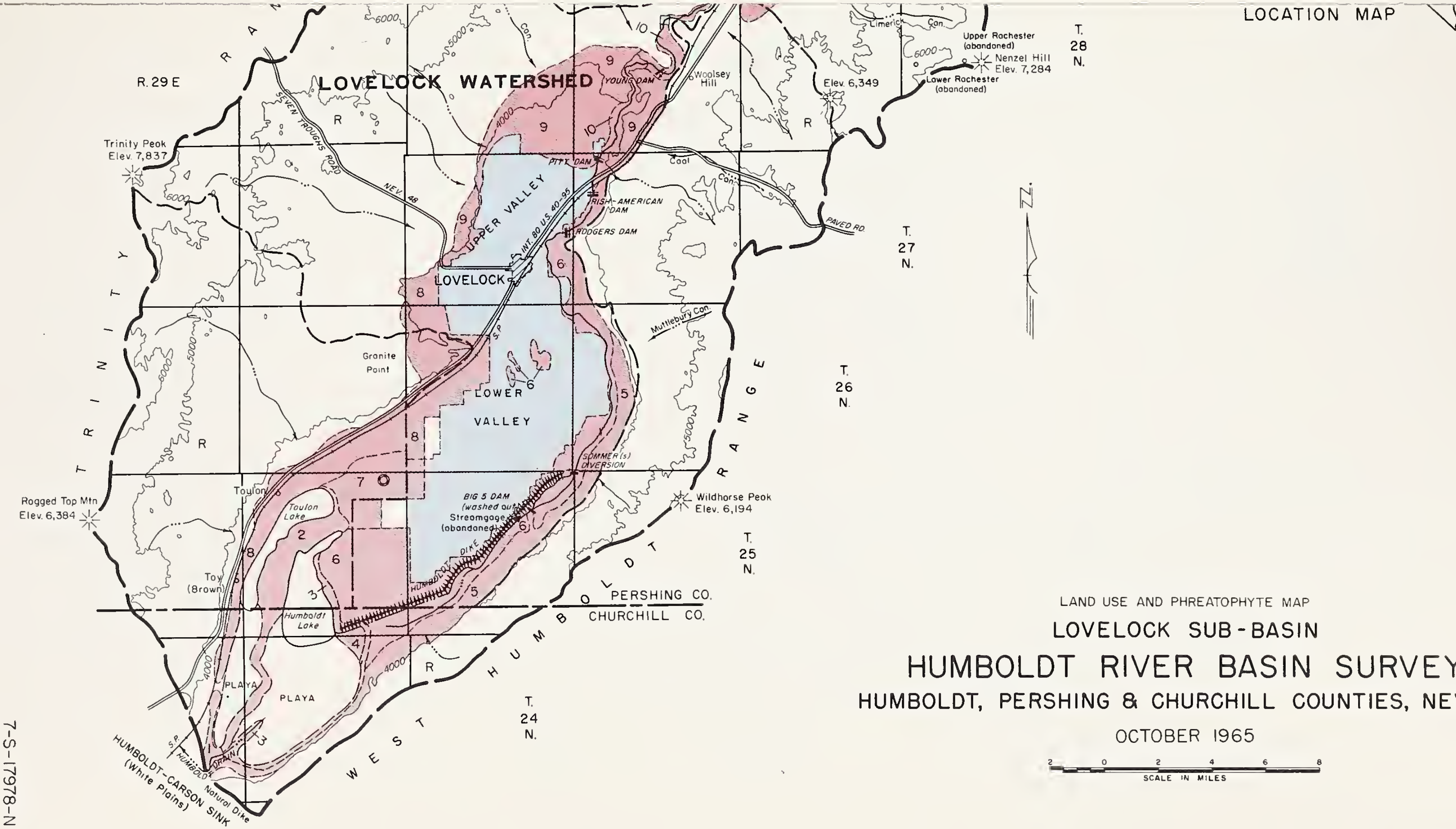
SOILS, RANGE SITES AND FORAGE PRODUCTION

LOVELOCK SUB-BASIN

HUMBOLDT RIVER BASIN SURVEY

HUMBOLDT, PERSHING & CHURCHILL COUNTIES, NEVADA

OCTOBER 1965



LAND USE AND PHREATOPHYTE MAP

LOVELOCK SUB-BASIN

HUMBOLDT RIVER BASIN SURVEY

HUMBOLDT, PERSHING & CHURCHILL COUNTIES, NEVADA

OCTOBER 1965

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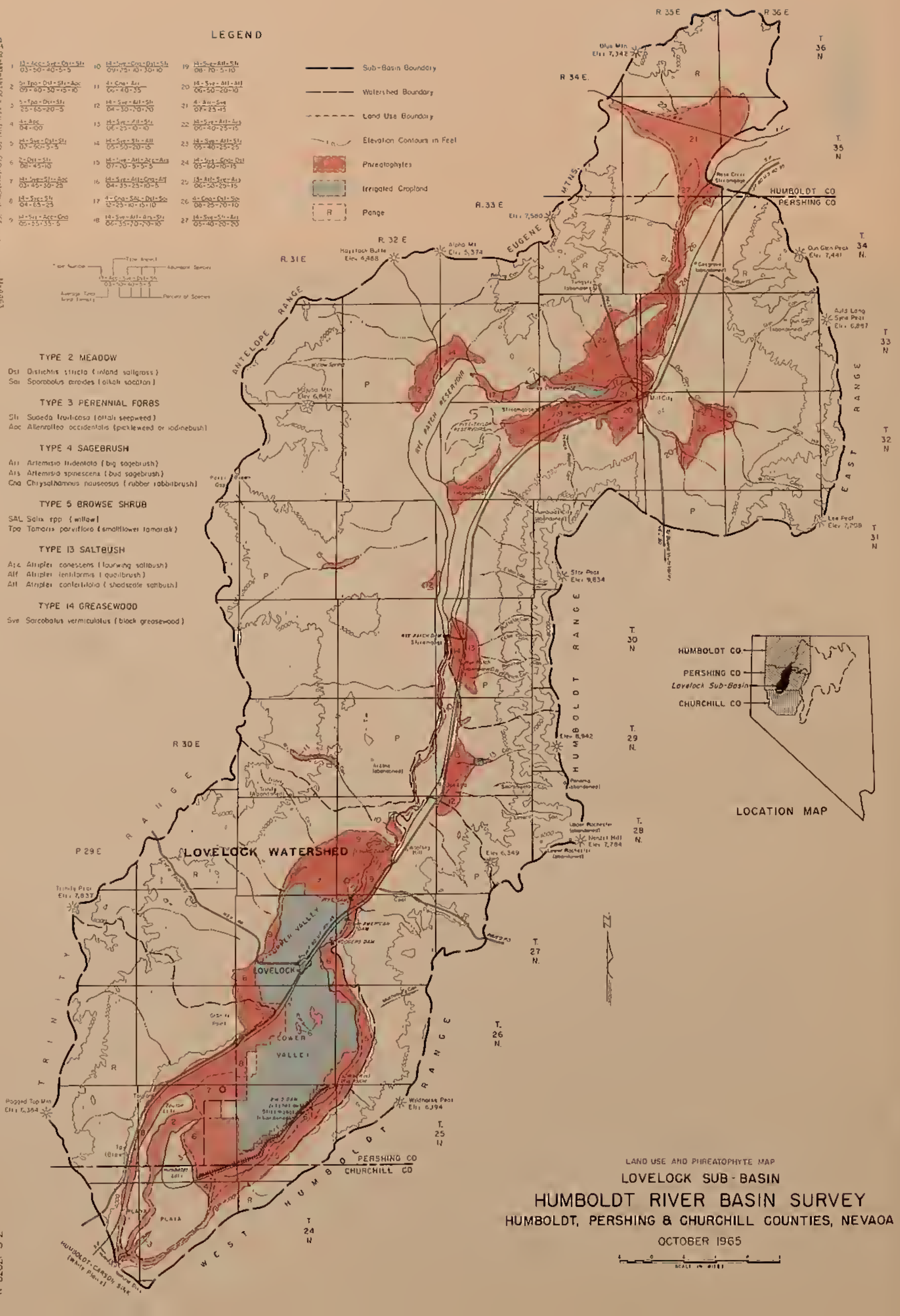

LAND USE AND PHREATOPHYTE MAP

LOVELOCK SUB-BASIN

HUMBOLDT RIVER BASIN SURVEY

HUMBOLDT, PERSHING & CHURCHILL COUNTIES, NEVADA

OCTOBER 1965